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Engineering News-Record

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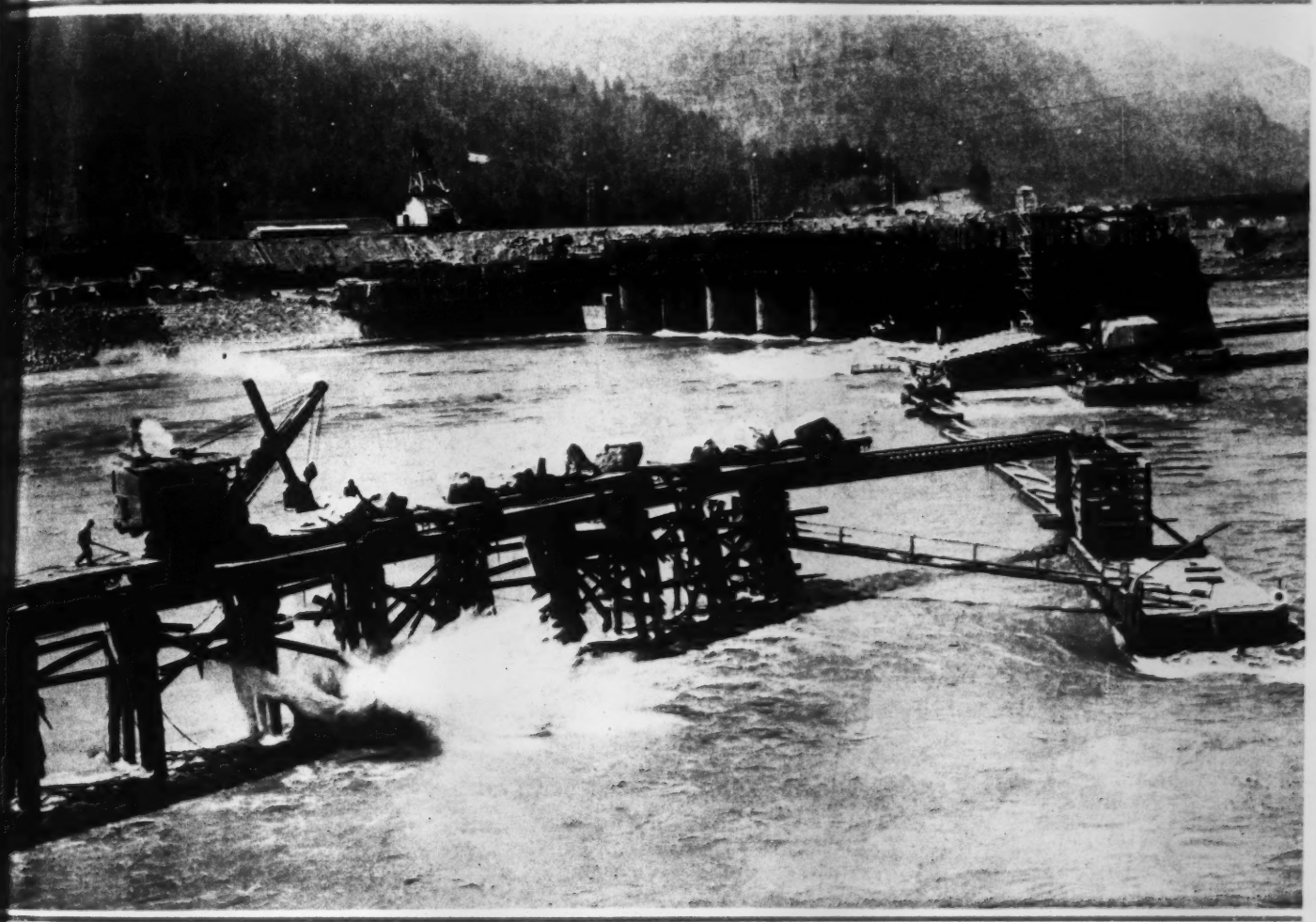

Flood-wrecked cofferdam at Bonneville Dam is repaired by jetty-building methods.

Cofferdam Problems: Bonneville and Grand Coulee

A Roadbuilding Holiday?

First of a Series of Articles Discussing Vital Highway Problems of Today

Reports on the Week's Conventions:

New England Water Works Association: Upstream P

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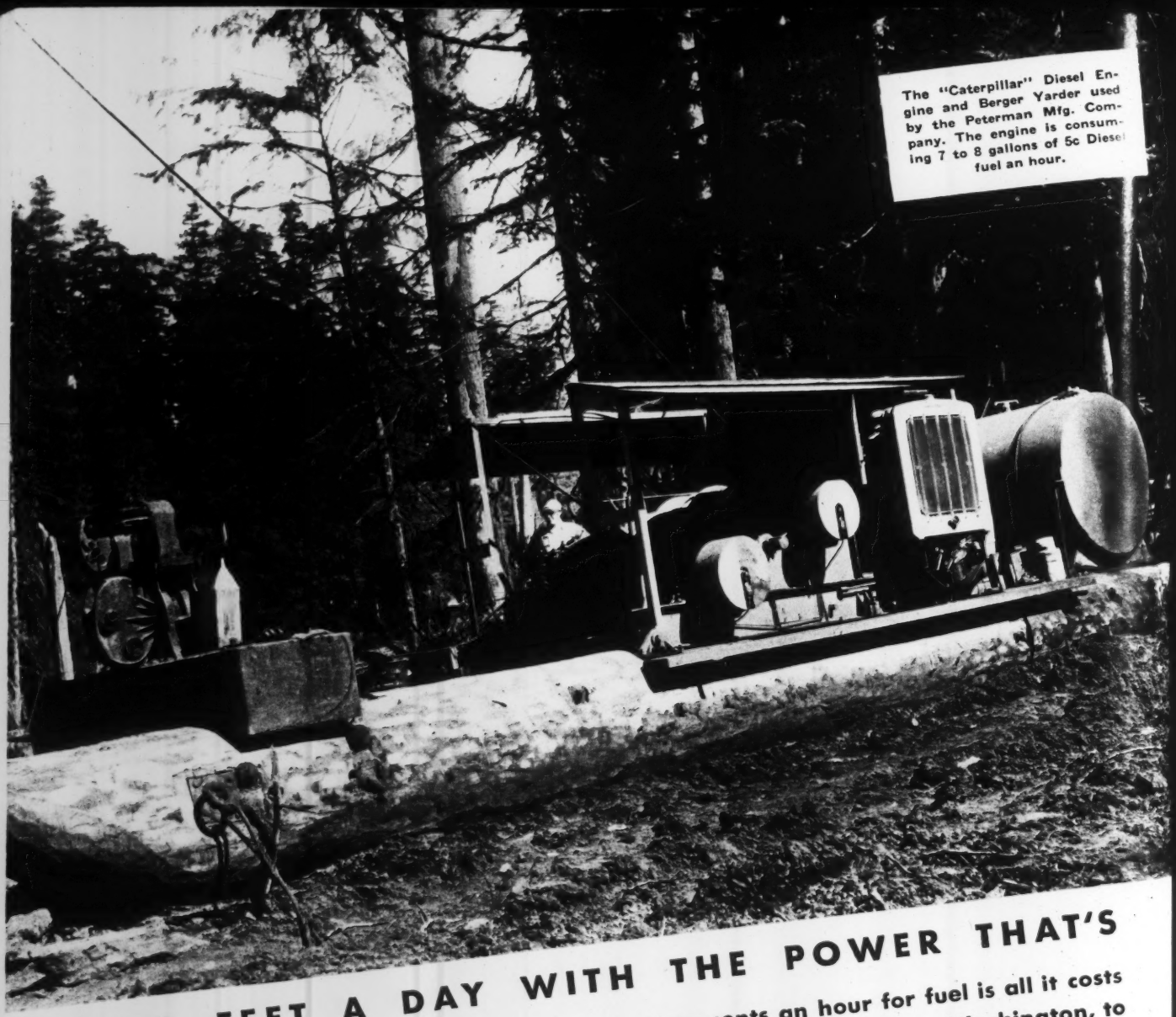

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Thirty-five to forty cents an hour for fuel is all it costs the Peterman Mfg. Company, Morton, Washington, to yard logs from woods to truck-loading landing. In an 8-hour day they average 150,000 feet. But on one record day, the power that's first—their "Caterpillar" Diesel Engine—handled 225,000 feet! Records of results in many fields prove the "Caterpillar" the world's foremost Diesel engine—FIRST in power, endurance, dependability, low up-keep, and low operating cost. Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

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Diesel

A MOMENT WITH THE PUBLISHERS

What Price PARKING?

WITH all the effort for more efficient municipal administration it is interesting to observe how little progress is made with the wasteful parking nuisance. It is not entirely clear why private individuals should be permitted to use the public streets for the storage of their cars at any time. And when the street areas thus preempted are so urgently needed for their intended purposes the mystery is deeper.

Consider, for example, certain business streets in New York City. To avoid congestion they have been made one-way streets. But from morning until night both sides of those streets are lined with cars, bumper to bumper, that cut the effective width of the streets from four-lane to two-lane. But that is not all. Delivery trucks must double park, which reduces the width to a single lane and often blocks the street altogether. Much of the time traffic through those streets is a mere trickle of cars that must await two to four light-changes to move the length of a block.

Yet on those streets the people of New York have taken some of the most costly real estate in the world, have graded, curbed and paved it and maintain it for the purpose of moving traffic and giving access to their property. They have provided for four lanes because they need four lanes. Yet a handful of individuals are permitted to preempt 50 per cent of that costly real estate in order to avoid a 50c. parking-lot fee, while the cost to thousands of others, in lost time, excessive fuel usage, loss of access and danger to life and limb is wholly ignored.

ALTHOUGH these conditions may be extreme, they are repeated in some measure in other cities with proportionate waste to the many for the benefit of the few. And not the least interesting aspect of it all is the success with which the beneficiaries seem to ward off any move toward curbing the abuse. To be a public nuisance seems to have become a vested right of the few that the many are bound to respect.

Some cities have abated the nuisance by installing parking meters. These, we are told, have reduced the storage parking; at least they are returning to the taxpayers something for the use of their property. But recently, when such a project was up in one city, both the leading newspapers had fits over it, because, they said, the public had provided the streets and should not have to pay for "using them." All of which overlooks the fact that the streets were provided to *move traffic* and *provide access* for the many, not to *store cars* for the few.

Much of the protest comes from certain merchants who fear that the suppression of the parking nuisance might interfere with their business. Without considering the merits of such a reason, and they are dubious, it would be interesting to know just how much the parked cars in the congested business sections actually contribute to the trade of the merchants. Factual surveys might reveal that parking, as now practiced, interferes so much with access that it is no more to the interest of the merchants than it is to the rest of the public.

EVENTUALLY the remedies for this abuse doubtless will include both short-term and long-term measures. Downright prohibition that will force parking out of congested districts and encourage the provision of parking facilities by private enterprise; installation of meters to foster a less thoughtless attitude amongst parkers; use of vacant lots under public auspices; condemnation of a certain area in each block for parking purposes, the cost to be recouped from parkers and from the remainder of the block; revision of building laws to require property owners to store the cars of their patrons off the public streets; these are but a few of the possible remedies.

But until the public demands an end to the nuisance, little will be done about it; and meanwhile the wonder remains that city dwellers will continue to put up with so flagrant an imposition on their patience and pocketbooks.

Willard Chevalier

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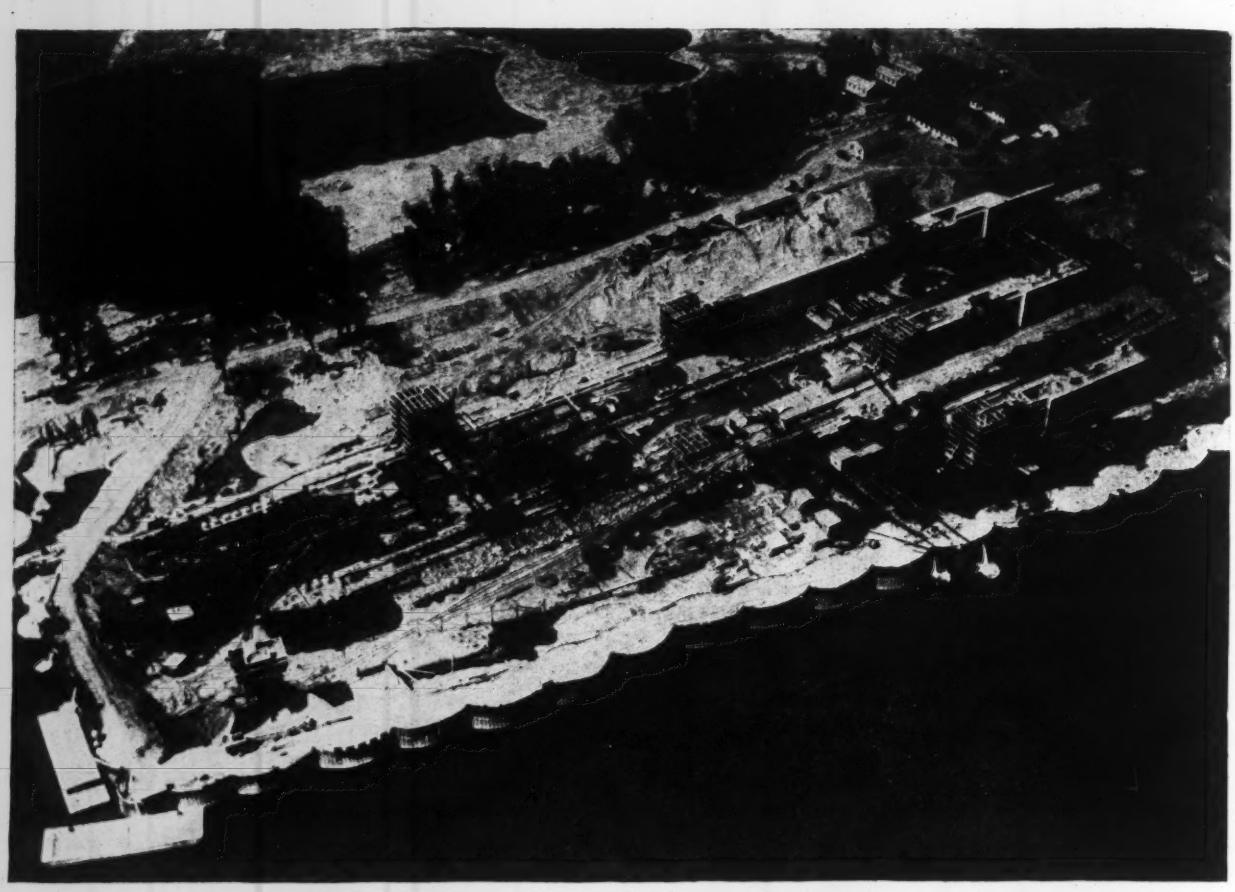

Inland Piling at Lock 25 On The Mississippi

Above: Construction photo of Mississippi Lock No. 25 at Cap Au Gris, Missouri. 1751 tons of Inland Section I-23 was used, some of the piles being 65 feet long.

This is the latest aerial photograph of the construction work underway on Lock No. 25 at Cap Au Gris on the Mississippi River.

The view clearly shows the neat tight job of Inland Steel Sheet Piling installed by the United Construction Co. United reports everything going well and work progressing splendidly.

This is but one of many successful Inland Piling jobs on the Mississippi. But Piling is only a part of the picture, for Inland Engineers work closely with the contractors from beginning to end, co-operating on design, method and construction until the job is completed.

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■

Thirty-three Simultaneous Equations had to be solved in designing the towers that support the 4,200-ft. span Golden Gate suspension bridge. Higher and heavier than any other bridge tower, each shaft in addition contains a greater concentration of steel than was ever before put in a steel member—12,000 sq.in. at the maximum section. The significance of the design procedure which made the towers possible needs no emphasis. The steps in this procedure are the subject of a feature article next week.

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Area	16.77 ins.^{2}
Driving Distance	18.0 ins.
Weight per lineal foot of pile	57.0 lbs.
Weight per square foot of wall	38.0 lbs.
Moment of Inertia	421.2 ins.^{4}
Section Modulus per pile	70.2 ins.^{3}
Section Modulus per lineal foot of wall	46.8 ins.^{3}

SPECIFICATIONS FOR MZ-32

Area	16.47 ins.^{2}
Driving Distance	21.0 ins.
Weight per lineal foot of pile	56.0 lbs.
Weight per square foot of wall	32.0 lbs.
Moment of Inertia	385.7 ins.^{4}
Section Modulus per pile	67.0 ins.^{3}
Section Modulus per lineal foot of wall	38.3 ins.^{3}

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ENGINEERING NEWS-RECORD

October 1, 1936

FIG. 1—MAKING THE FILL that was swept away. View from Washington shore looking along upstream arm of second-step cofferdam. One of the downstream cribs is under construction in center.

Jetty Construction Methods Used to Repair Bonneville Cofferdam

THE SUMMER PEAK FLOW in the Columbia River came early in 1936 with little warning and a rapid rise. Thus flood waters caught the second-step cofferdam of the Bonneville Dam at a time when serious damage could result from overpour. The intention had been to have the cofferdam completed well in advance of high water which would have permitted immersion and overflow without damage, as was the case on the first-step cofferdam. The procedure in construction of the second-step cofferdam follows closely that for the first-step, which was described in *ENR*, Sept. 5, 1935, p. 315. This season, however, a floodflow of 520,000 sec.-ft. overtopping the upstream arm of the second-step cofferdam found a channel of escape through the unfinished downstream arm, and a head differential of 8 ft. was developed between the upper and lower sides of the upstream arm. Under these conditions the overpour swept away 42,000 cu.yd. of earthfill and riprap on the Washington end of the upstream arm; carried away three nearly completed cribs for the downstream arm; scoured the river bottom slightly and swept out loose material along the Washington shoreline.

The cribs that had floated downstream were towed back to the dam and measures were undertaken immediately to close the breach and complete the cofferdam. Because of the swift current and the volume of flow, however, closure required methods ordinarily used on jetties exposed to heavy wave action. Altogether the cost of repairing the damage is estimated at about $150,000.

Original cofferdam design

The upstream arm of the second-step cofferdam originally had a length of 610 ft. It was built of eight timber cribs each 60 ft. long and an earthfill 130 ft. long at the shore end covered with an 8-ft. layer of heavy riprap. This fill was brought up higher than the tops of the cribs, had a top width of 20 ft., and slopes of two to one both up and down stream. If both arms of the cofferdam had been finished before high water a pool would have been retained within the completed cofferdam, the greater part of the floodflow would have been over the crib portion of the upstream arm and with water level practically equal on both sides of the earthfill there would have been no danger. Under conditions after completion, instead of scour within the cofferdam, deposition would have occurred.

On April 10, while the downstream arm was still lacking four of the 60-ft. cribs, the river began a very early and sudden rise. From a flow of 77,000 sec.-ft. the rate increased to a maximum of 520,000 sec.-ft. in three progressive peaks within five weeks; two of these came without much intervening decrease in flow. On May 14, when the flow was 452,000 sec.-ft., the earth and rockfill at the Washington shore end of the upstream wing was overtopped. With the swift current flowing out through the uncompleted gap in the lower arm, the head differential on the two sides of the fill in the upstream arm reached 8 ft. The unprotected material of the shore fill was rapidly eaten away by the swift water and soon was entirely carried out, leaving a gap 130 ft. wide between shore

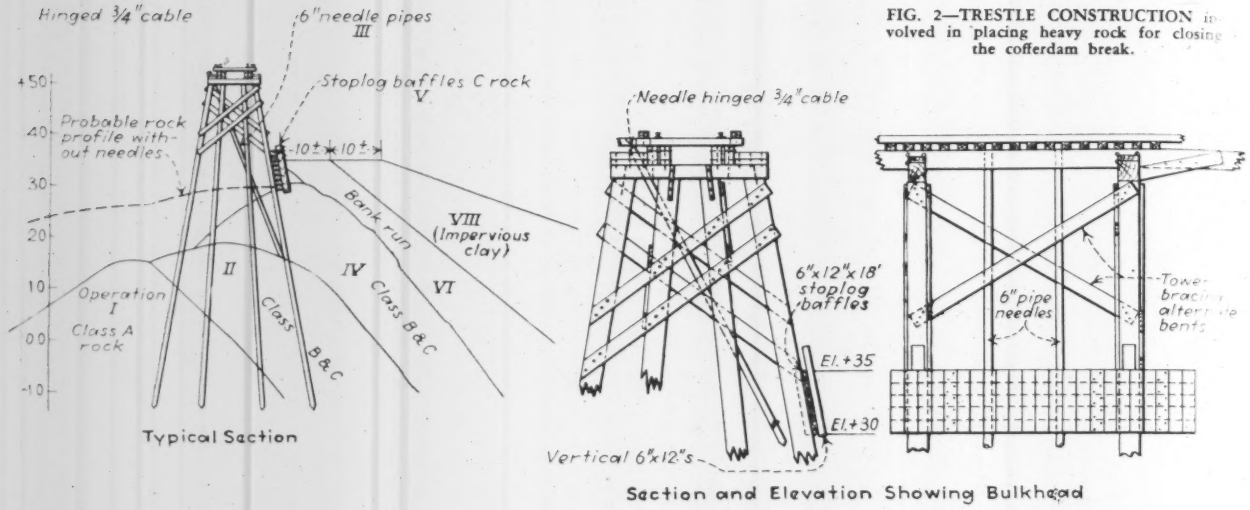


FIG. 2—TRESTLE CONSTRUCTION involved in placing heavy rock for closing the cofferdam break.

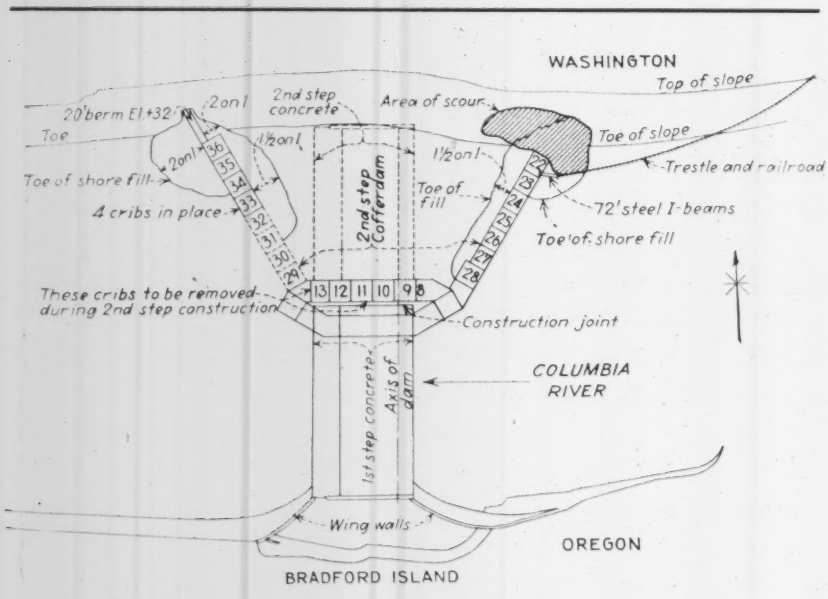


FIG. 3—PLAN OF SPILLWAY DAM showing first and second cofferlam steps with breach that was opened in the latter. Closure was by means of the long trestle on the upstream side.

and the nearest crib; the water depth in this gap was about 75 ft. In addition to taking out the fill, both shore and bottom were scoured slightly. However, this was material which would have been removed anyway so no loss was involved. The cribs of the upstream arm were undamaged and remained in position during the period of overpour.

Various methods considered

Various methods of closing the break were considered. Dumping rock from barges was slow and difficult. The current had a velocity upward of 20 ft. per second and in a depth of 75 ft. even the heaviest rocks that could be handled were carried downstream so far before reaching bottom that their placement could not be controlled with certainty. Nor could a trestle be driven readily in such deep, swift water. Decision then was reached to build a trestle from a point well upstream, whence it could cut diagonally into the current, taking advantage of shallower water and less velocity than within the break itself. This method succeeded and by effecting closure of the breach earlier than otherwise would have been possible, even on a falling river stage, saved several weeks time during the low water season. (This time is urgently needed to complete this stage of the project before the next flood season.) A condition favoring this method was the availability of ample large rock in a quarry 30 miles distant by rail. This quarry and the equipment available with it were used in building the recently completed south jetty at the mouth of the Columbia River.

Before starting the trestle, rail connection with existing tracks on the north shore was effected by building about 1,500 ft. of new trackage, including a portion laid on a bench cut excavated down to the river's edge. From the river end of this cut to the crib nearest shore in the upstream cofferdam arm, the distance which the trestle was required to span was about 700 ft. The major portion of the trestle was built of four-pile bents on 16-ft. centers. Pile lengths ranged up to 70 ft. and the penetration obtained was sometimes as little as 2 ft. The last few bents nearest the crib were omitted and instead the track was supported on 72-ft. steel I-beams, spanning from the last bent to a timber framework built up on the crib top. The bent design used is shown in Fig. 2.

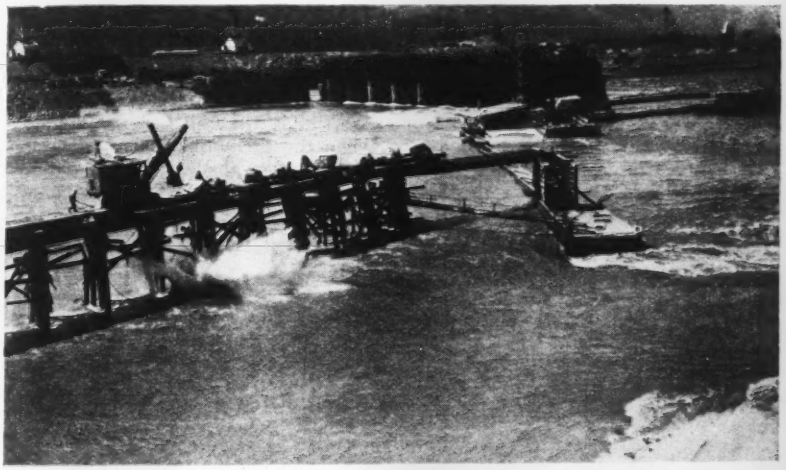
With completion of the trestle the first filling operation was the dumping of rock on the downstream side to form a substantial toe for the fill. This rock is marked "Operation I" in Fig. 2. This was followed by the successive dumping operations indicated numerically in Fig. 2. Material classifications were as follows: *A* rock ranged from 6 to 30 tons in weight and averaged 10 tons. *B* rock ranged from 6 tons down to 18 in. and *C* rock includes sizes below 18 in. The proportions required were: *A*, 45 per cent; *B*, 30 per cent; *C*, 25 per cent. The fill as completed was to include 37,000 tons of heavy rock and 5,000 tons of quarry waste. In addition to this the blanket of gravel and clay was to include about 42,000 cu.yd. of material.

Pipe needles anchor fill

As a means of pegging and steadying the rock pile, needles consisting of 6-in. pipes were placed between bents on the outer portions of the trestle. No attempt was made to drive these pipes, they were simply lowered into place with their ends resting on top of the rock and then more rock was dumped around them, anchoring them firmly. Use of pipes began about 300 ft. from shore with a single

FIG. 4—UNSUCCESSFUL METHOD: Dumping large rock from a barge in the breach where water depth was 75 ft. and velocity exceeded 20 ft. per sec. At right, water is overtopping cribs of upstream arm.

FIG. 5—SUCCESSFUL METHOD: Rock up to 30 tons in weight dumped from a trestle closed the breach shown in foreground. Water stage lower than in Fig. 4.



pipe midway between bents. After five deck spans were so provided, the remainder of the trestle was built with two pipes per span, set at the one-third and two-thirds points. These pipes are believed to be effective in stabilizing the rock to such an extent that the fill was made with a steeper downstream slope than otherwise would have been feasible.

Test with ropes and buoys attached to the large rock dumped in the first operation proved that they came to rest in the desired location where they would serve as a toe to hold the remainder of the fill that was to follow. Gravel and clay filled the interstices and made the structure as a whole tight. On top of the dike thus erected a timber bulkhead was placed, supported by piles of the trestle, to finish off the work and take advantage of the trestle support for resistance to as high a water level as possible.

Construction started on this method of closing the breach on June 10 and the fill placed from the trestle was completed July 17. Although considerable loss in time and money resulted from the unusually early arrival of high water this year, this has been somewhat offset by the unusually early subsidence. In the matter of completing the second-step portion of the concrete—that is, the portion within the second-step cofferdam, it is believed that if the cofferdam is unwatered this season, as expected, the concreting can be finished in June, 1937.

Although this year (1936) there was an earlier start on the second-step cofferdam, as compared to corresponding falling river stage in 1935, and the yardage of concrete to be placed is less (261,418 cu.yd. in the second step as compared to 275,425 cu.yd. in the first step) there is considerably more work to be done during the coming low water season. Last year the cofferdam was completed and some excavation finished before high water; this year much of the cofferdam work and all of the excavation remain to be done. Under these conditions the low water season during the coming winter will be a busy time and even though some of the latter part of the work can be finished after the rise begins, the job will be a race against time and high water to be expected in the summer of 1937.

The Bonneville project is being constructed under the direction of the Corps of Engineers, U.S. Army. Col. Thomas M. Robins is division engineer, Lt.-Col. Chas. F. Williams is district engineer and Capt. Colby M. Myers is officer in charge at Bonneville. C. I. Grimm is head engineer for the division, A. E. McKennett, principal engineer for the district, and B. E. Torpen is senior engineer at Bonneville. The contract is held by the Columbia Construction Co., Henry J. Kaiser, president.

Transportation for Traveling Municipal Employees

HOW MUCH should a city employee be paid when he uses his own automobile on city business? *Public Management*, journal of the International City Managers' Association, reports that there is no standard, the reimbursement depending on numerous factors.

Flat rate allowances are most popular, according to the report. The allowance ranges from $10 to $100 and over a month, but the average is probably between $20 and $40. This plan assumes that all allowances cover only the cost of gas and oil. It is easy to administer but, in practice, gross inequalities frequently are found. High ranking officials often are given generous allowances in spite of the fact that they may use a car for only a few hours during the day, while lesser officials and employees who use their cars almost continually, receive the same or even lower allowances.

A number of cities use a mileage fee plan, the payment ranging from five to ten cents a mile. To be effective, however, the report says, this basis of compensation should depend upon daily speedometer or hubometer readings.

Still other cities make various allowances for gas, oil, and sometimes repairs. Under such a system, it is commented, employees are bound to use some city gasoline while traveling on private time, and it is not an unknown practice for unscrupulous employees to resell supplies, and to their profit.

The whole system of allowances for private cars is open to a number of criticisms, *Public Management* says. It may save the city capital outlay for automobiles and for garage facilities, it may simplify record-keeping, and it may result in more careful driving of the cars because they belong to the employees themselves, but it seldom is based on scientific cost analysis. As a result, most cities using this plan pay a good deal more than is justifiable for the transportation they receive.

In most cases, the greatest economy and best service are probably to be obtained by some central transportation bureau with a dispatching system.

Program for Grand Coulee's Second Cofferdam

U-section cribs to permit gradual closure with stoplogs—Cribs of different design in upstream and downstream arms—Unwatering of present river channel set for latter part of December

NOW that more than a million cubic yards of concrete has been placed in Grand Coulee Dam within the area protected by the west cofferdam, plans have taken definite shape for constructing the cross-river cofferdam. When that structure is ready the west cofferdam is to be removed and the Columbia River will be diverted into what is now the west cofferdam area. The junction blocks of the west cofferdam (sections *D* and *G*) are to serve as parts of the cross-river cofferdam. These junction blocks are already tied in to block 40 of the dam, to form the west wall of the enclosure. The program therefore calls for an upstream and a downstream arm extending from sections *D* and *G* to the east bank. By putting in the downstream arm first, actual closure of the river channel will be accomplished in that arm and the upstream arm then can be placed in still water using coffers of somewhat simpler design.

Endeavor has been made to advance the placing of concrete in the west cofferdam so that if the cross-river cofferdam is completed as planned, diversion from the present river channel can be effected during the coming winter which is low water season for the Columbia River. The channel to be provided over concrete placed in the west cofferdam will have sufficient capacity so that only a slight rise in head on the cross river cofferdam will be caused by channel obstruction. (The ordinary seasonal rise in water level at this point on the Columbia River ranges from about 40 ft. to a maximum of 67 ft.) The design of the cross river cofferdam is such as to resist a flood level of about 60 ft. above low water level.

Preparatory work

In planning construction of cribs for cofferdams in the present river channel the first move was to construct a sounding barge with which to make accurate depth measurements at the locations where the cribs are to be placed. For this purpose a pile driver barge was fitted with 4-in. double extra heavy pipe hinged near the top of the leads and accurately marked for observation with three transits and a level on shore. The sounding pipe was arranged to slide in a crosshead operating in the pile driver leads. Soundings were taken at 2-ft. intervals in each direction and readings were made to a tenth of a foot. Experience with this rig shows that it is possible under favorable conditions to take 100 shots per hour.

With the information obtained from this accurate survey of bottom irregularities it will be possible to plan and build crib bottoms of the exact shape to fit their respective locations. The bottoms of the cribs, on which the careful work must be done to make the surface shape conform to the streambed irregularities, are to be built in the dry to a minimum height of 5 ft. From this point on the construction becomes standard and can be carried on either in the dry or afloat.

As a preliminary to the later removal of the upstream arm in the west cofferdam, excavation has been begun on the outside berm and also on the area just inside of this arm. After the fill on the outside has been taken down somewhat the plan is to burn holes 2 ft. square in the steel sheetpiling that constitutes the cells of the cofferdam. Then the fill within these cells can be sluiced out through these openings down to El. 960. After the sluicing, it

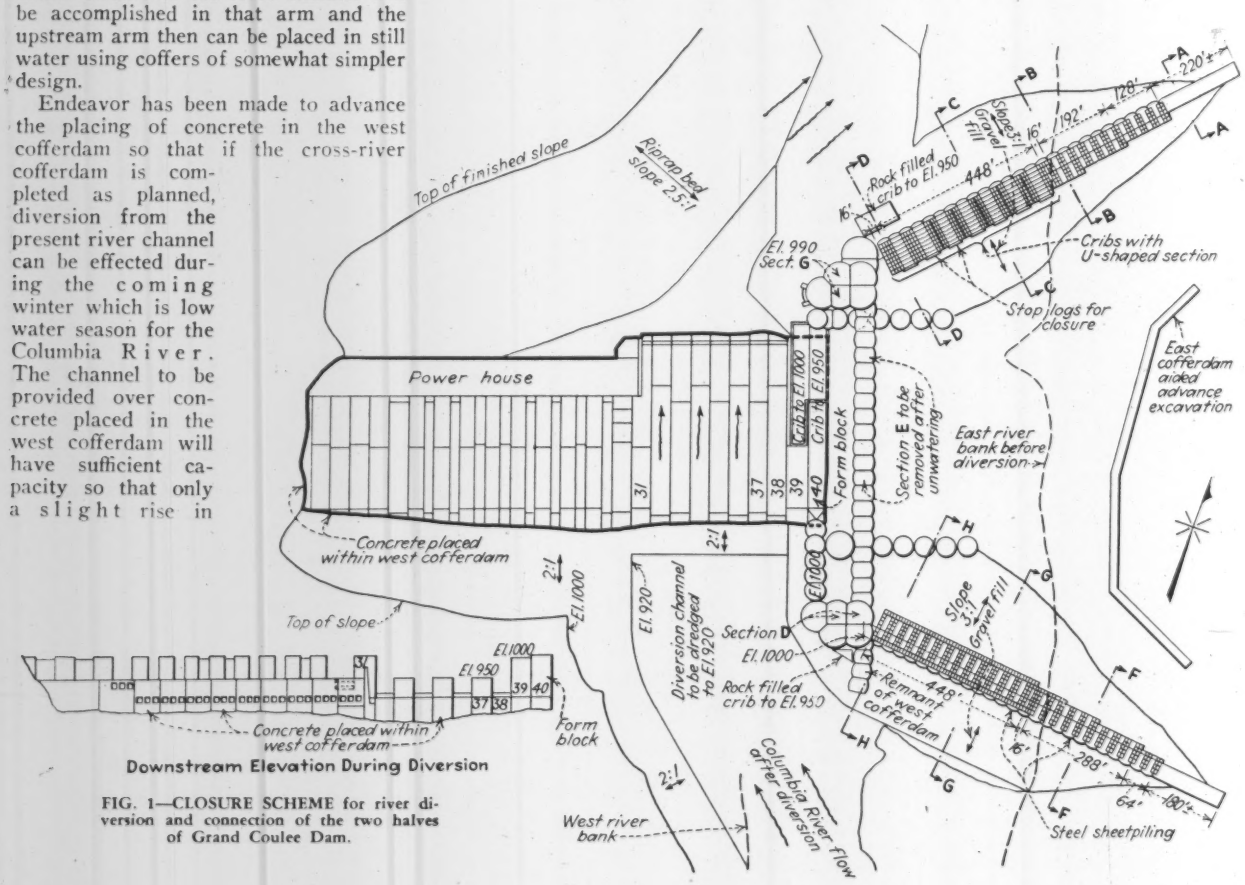

Top of finished slope
Riprap bed slope 2.5:1
Rock filled crib to El. 950
Slope 3:1 Gravel fill
Cribs with U-shaped section
Stop logs for closure
El. 990 Sect. G
Power house
Crib to El. 1000
Crib to El. 950
Form block
Section E to be removed after unwatering
East river bank before diversion
East cofferdam aided advance excavation
Concrete placed within west cofferdam
Top of slope
El. 1000
El. 920
Diversion channel to be dredged to El. 920
Section D
Rock filled crib to El. 950
Remnant of west cofferdam
Columbia River flow after diversion
West river bank
Steel sheetpiling
Downstream Elevation During Diversion
Concrete placed within west cofferdam
Form block

FIG. 1—CLOSURE SCHEME for river diversion and connection of the two halves of Grand Coulee Dam.

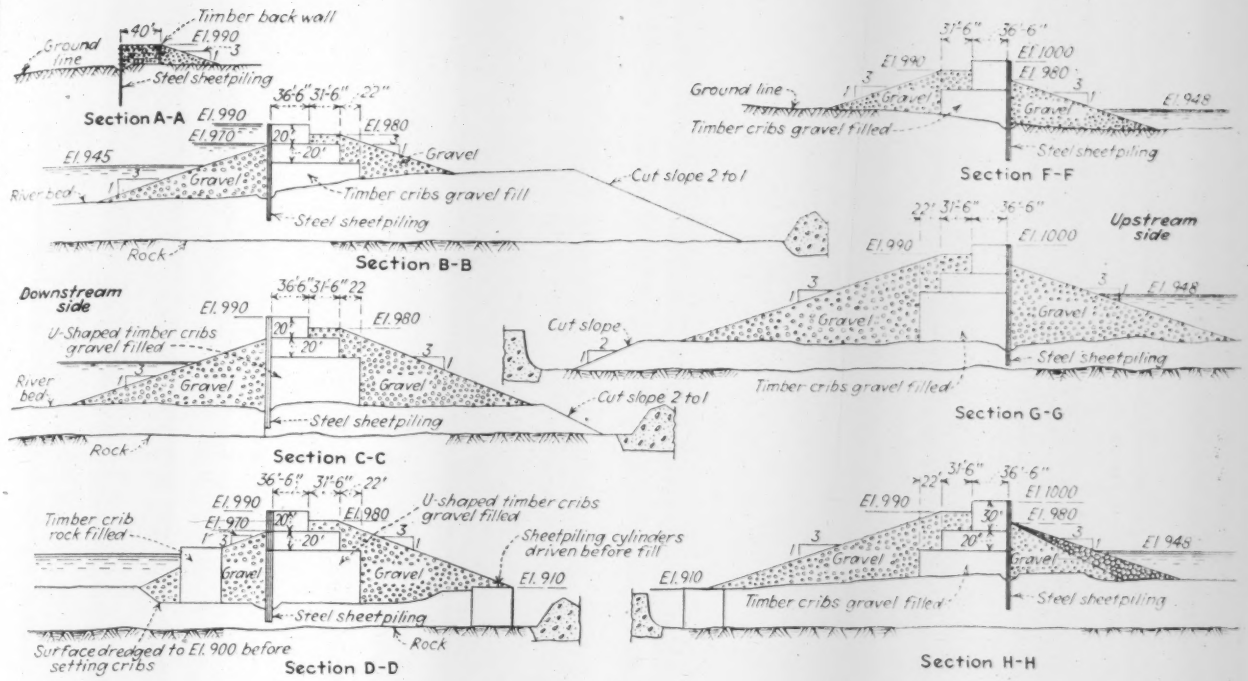


FIG. 2—CROSS-SECTIONS in cross-river cofferdam taken at locations indicated in Fig. 1.

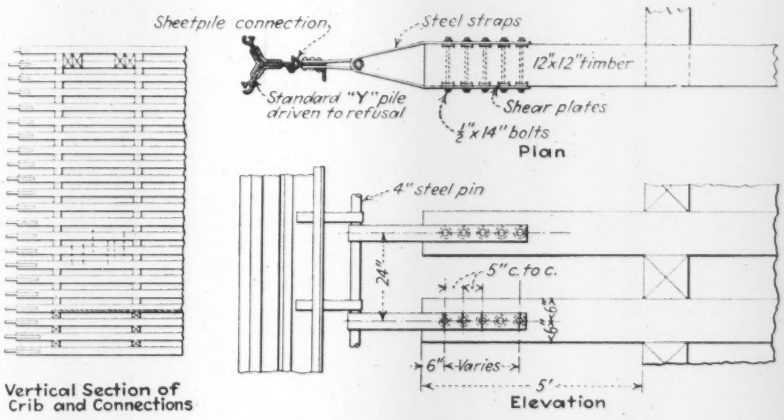


FIG. 3—CONNECTIONS which fasten Y-sections in the sheetpiling facing to the timber cribs.

will be possible to remove the timber backwall, tie rods and timber bracing within the cells, and then the sheetpiling can be cut off and removed to the 960 level. The next step will be to excavate the fill outside the cells (probably with a dragline) to El. 910. The fill within the cells then can be removed by clamshell to this same level. This will leave only about 20 ft. of penetration and it is expected that the remaining sheetpiling can be pulled.

Excavation within the west cofferdam prior to river closure is to clear off a level area behind the upstream cofferdam arm and in this area, except for a berm 30 ft. wide immediately back of the upstream arm, excavation will be carried down to El. 920. A two to one slope will be left back of the 30-ft. berm. The area cleared off to the 920 level will be large enough to permit the laying out of all fourteen of the cribs to be used in the up- and downstream arms of the east cofferdam. Thus a suitable area will be available for the careful work of building up the tailored bottom portion of these cribs.

Starting the cross-river cofferdam

The start of the cross-river cofferdam will be on the downstream arm at the eastern end. This will be done in the dry as low water approaches. This arm will consist of three sections: Beginning at the shore end there first will be 220 ft. of Ohio River-type cribs (vertical sheetings, horizontal walls and tie rods), then 336 ft. of built-in-place cribs followed by 448 ft. of cribs with a *U*-shape cross-section floated into place and sunk, thus making the total length of the downstream arm 1,004 ft.

The *U*-shaped cribs will be 90x64 ft. in plan with a maximum height of 40 ft. at the time they are floated into place. The 90-ft. dimension is parallel to direction of stream flow and the *U* section makes what is in effect a trough through which stream flow can pass. As each crib is placed streamflow will continue through the trough so that at low water a head of not more than 2 ft. will be developed between up- and downstream sides of the cribs. After all the cribs are in place and properly secured the *U*-shaped openings are to be closed gradually by stoplogs.

The base section of these cribs, 15 ft. high, will receive rock ballast in the pockets provided for the purpose, so that they will settle gradually in the water as the sides are built up to a height of 10 ft. more than water depth at the location where they are to be sunk. For the most part 12x12-in. timbers will be used and diagonal steel rods will be put in to reinforce the cribs as they are built up. After the cribs are sunk and brought up to full height tie beams consisting of double 16x24-in. timbers are to be placed on top, spanning the open end of the *U*, to form two roadways on which trucks can move out over the completed cribs.

Cribs built up to a height exceeding water depth by 10 ft. will be bulky to maneuver into place and heavy equipment is provided for this operation. The maneuvering barge will have four 2-in.

cables to a crib, thus giving almost universal control, to effect accurate placement. The barge itself is to be anchored to a point upstream by means of a 3-in. holding line. Hoisting engines on the east and west banks will control the side movements of the crib.

Stoplogs for closure

On the upstream face of each crib vertical guides will be put in for the stoplogs. The latter will have a span of 32 ft. and each stoplog will be made up of three 12x18-in. timbers. Thus an additional head of 3 ft. is to be developed by each stoplog. By putting down the stoplogs in adjoining openings successively the plan is to carry a 3-ft. lift entirely across the channel before placement of stoplogs in the next lift in any crib. The total thickness of the vertical portion of the *U*-shaped cribs equals the total width of the trough openings. Thus the plan of closure contemplates leaving one-half the cross-sectional area of the channel to be closed by stoplogs.

After the stoplogs are in place steel sheetpiling is to be driven along the downstream face of the row of cribs. In preparation for this a clamshell on a whirler moving along the top of the crib is to clear an 8-ft. width of ditch on the bottom along the line in which the sheetpiling is to be driven. The piling is to be driven to a depth of 15 ft. into the stiff clay river bottom before the filling of the cribs begins. The sheetpiling will be connected to the cribs at each of the vertical sections between the *U*-shaped troughs. Detail of this connection effected by a vertical bar and a *Y*-section of the piling is shown in Fig. 3.

With stoplogs and sheetpiling in place, filling of the cribs is to be done by dumping from motor trucks working out from the shore end. The fill inside the cribs and against the sheetpiling will be kept ahead of the fill on the outside so as to keep the sheetpiling under pressure from within. The fill is to be placed on both sides of the cribs; slopes on both up- and downstream sides are to be 3:1 as shown in Fig. 2. The filling material will include some rock but mostly it will be borrowed from a sand and gravel deposit.

A feature of final closure in both the up- and downstream arms of the cross river cofferdam will be the cribs at the outer end of the earthfill where connection is made between the cross-channel arms and sections *D* and *G* which are parts of the west cofferdam.

On the outside of the fill (both up- and downstream) it will be necessary to float into place a timber crib to protect the end of the fill from the high water velocities of next year's floodflow. One of these cribs is to be 50x100 ft. in plan; both are to be built in a manner similar to that used in the up- and downstream arms. On the inside of the cross-river cofferdam, however, the toe of the fill can be placed under protected and more favorable conditions. To keep the inner slope of the fill from encroaching on the area in which concrete is to be placed, circular cells consisting of steel sheetpiling are to be formed by driving the piling into the river bottom.

The upstream arm of the east cofferdam is to be placed in still water after closure of the downstream arm. Working out from the east bank the first 180 ft. will be of the Ohio River-crib type, then 376 ft. of cribs built in place and finally seven cribs with a total length of 448 ft. that will be floated to place and sunk. Thus the total length will be 1,004 ft. The cribs to be floated in will have a shape, in plan, resembling a dumb-bell with square corners. Thus when these cribs are placed the river channel will be completely closed and the heads of the dumb-bells will constitute the foundation for a truck roadway. Sheetpiling on the outer side of this arm will be placed in the same manner as on the downstream arm. With the sheetpiling in place filling is to be carried out from the shore end by trucks dumping first behind the sheetpiling and ultimately on both sides to bring the fill slopes up to three to one against outer ends formed by crib and circular cells as already described.

The vertical face of concrete on the river end of that portion of the dam already placed within the west cofferdam has been closed off preparatory to flooding the west cofferdam. This closure will be carried above high water level so that after the cross river cofferdam is pumped out the river section *E* can be removed to permit connecting up concrete poured in the cross river cofferdam with that already placed on the west side of section *E*. In Fig. 1 it will be noted that the cellular construction above and below the concrete in blocks 39 and 40 is tied in by cribs and sheetpiling cells so that the river arm *E* no longer will be essential after the cross-river cofferdam construction is completed. The area within the cross river cofferdam will be about 70 acres as compared to the 60 acres within the cofferdam on the west side.

The present schedule is for the west cofferdam to be opened to permit water to flow over the west side sometime in October, 1936. When this is done it will be possible to begin immediately on placing the cribs in the two cross-river arms. If this procedure is carried out as planned, the stoplogs in the downstream arm can be put in late in December of this year. This will be real closure of the river section and actual diversion to the area now occupied by the west cofferdam. The newly completed cofferdam arms then must be raised before April, 1937, to a height sufficient to resist the high water of next summer. On top of the cribs that are to be floated into place and which will then be carried up to El. 950, there will be two additional steps to increase the height. The first of these will be 68 ft. wide and will add 20 ft. to the height, bringing the crest up to El. 970. Another 20-ft. step 36½ ft. wide will bring the ultimate top to El. 990. Location of these additions to the cofferdam arms are shown in Fig. 2.

Personnel

Grand Coulee Dam is being built by the U. S. Bureau of Reclamation, R. F. Walter, Denver, chief engineer; F. A. Banks, construction engineer at Grand Coulee Dam. The contract is held by the M.W.A.K. Co., George H. Atkinson, general manager; C. D. Riddle, chief engineer.

Steep Grade Becomes Non-Skid When Wire Mesh Covers Planks

IN HAULING MUCK from the south portal of the Whites' Point sewer outfall near Los Angeles it is necessary for the motor trucks to climb a few hundred feet of grades ranging up to 17½ per cent; this is because the portal is protected by a cofferdam. There was the alternative of using these steep grades or rehandling the muck through a lift or skip of some sort. Conditions were complicated by the fact that part of the roadway had to be built on a sharp curve.

The most convenient form of construction was a timber trestle for part of the road with the entire incline surfaced with longitudinal planks. This plan was followed and trucks "made the grade" quite satisfactorily up to the time of the rainy season. By then the planks had been worn smooth, the wheels would slip and traction was lost. This condition was remedied easily, however, by use of ordinary lightweight 2-in. wire mesh stapled down to the planks along the wheel tracks. On the portions of the roadway built on tangent, mesh strips of 18-in. width were used; on the curves, where front and rear wheels did not track exactly, 30-in. widths were laid. This plan effectively stopped the slipping and loss of traction and there was surprisingly little wear on the mesh.

The hauling is being done for the Los Angeles County Sanitation Districts by C. E. Rhoades on a subcontract for Shofner & Gordon & Hinman Bros., the general contractors.

CURRENT HIGHWAY PROBLEMS—I

A Highway Holiday .

It is not beyond possibility but all experience and reasoning indicate that disastrous and far-reaching results would follow such a course.

By H. S. Fairbank
Chief Division of Information, Bureau of Public Roads, Washington, D. C.

SHALL we take a roadbuilding holiday? There have been many assertions, particularly during the period of straitened finances and idle days from which the people are tediously emerging, that such a holiday would be wise. This is the natural conclusion of ignorance, and the general ignorance of people, even those who should be informed of the vital function that roadbuilding and highway transport perform in modern life, extends the horizons of astonishment. This first article on current highway problems is a statement of facts and reasons that make plain why, instead of taking a holiday from roadbuilding, wise and prudent people should take on new determination to improve roads. Few writings have presented the situation so plainly as does the article that follows and few writers have made blunt fact and criticism more acceptable. —EDITOR

TO THE PROPOSAL of a roadbuilding holiday, more or less regularly put forward, the first impulse is to say, with the lawyer whose innocent client has been jailed: "It can't be done." With benefit of second thought a less positive assertion appears advisable for the same reason that moved the lawyer's client to retort: "It has been done."

Not that there has been, or is likely to be at any time, a complete cessation of all roadbuilding activity. The proposal is generally not quite so sweeping. But there have been at least two notable trials of what may be termed a partial holiday, experience of which would appear to justify at least the milder assertion that: "It can't be done without seriously harmful effects, immediate and far reaching."

There are those who may recall that road building was held during the World War to be a "non-essential" industry, and as such was to be allotted the barest stint of labor and materials. More, doubtless, remember the disastrous results of the roadbuilders' struggle, so deprived, to hold none-too-ready road surfaces against the onslaught of an overwhelming movement of army trucks that was *not* held to be "non-essential." At least one highway official, surveying the aftermath of that holiday, was moved to submit an uncollectable claim for damages to those at whose behest the holiday was taken.

But, if there are few who remember these now historic incidents, there are many who know that, but for the largess of the federal government we should now be enjoying the similar consequences of a holiday that was ordered in the name of retrenchment and budget balancing in the early days of the depression. The evil results of that holiday also were quickly manifest—results that took the forms of disrupted highway engineering organizations, insolvent contractors, inactive and almost idle road material and equipment industries, and another large body of out-of-work labor.

All such damage has now apparently been repaired with the federal funds that were poured out for the purpose, but the retrogressive acts of states, counties and cities are in many instances uncorrected and will again give trouble if and when the federal contributions are materially reduced. Abolished property taxes will be difficult to reimpose. Diverted motor vehicle revenues will be hard to get back. The habit of letting George do it will not easily be broken. Yet nothing is more certain than that, soon or late, the state and local governments will have to reshoulder their cast-off burdens. Although, at a price, it is possible to take a holiday, no holiday can last for long. If the true cost of a roadbuilding holiday were appreciated there would be few indeed who would entertain the suggestion.

That there are many who are willing still to entertain it means simply that there are many who, incredible as it may seem, still think of highways as luxuries; who fail utterly to comprehend the dependence of the modern economic structure on highway transportation; who have no adequate grasp of the magnitude of the investment already made in the highways or of the necessity of protecting that investment against the steady erosion of depreciation and obsolescence. It means that there are many, too, who have no conception of the magnitude of the industrial organization employed directly and indirectly in the building and maintaining of the highways, or of the serious economic repercussions that must inevitably follow any disturbance of the normal functioning of that organization. It means that many have no sufficient knowledge of the actual state of the highway system or of the further improvement demanded by the existing traffic; and little or no understanding of the processes by which the present structure has been created and by which further improvements must be affected.

True cost of a road system

Generally it will be found that those who accept the idea of a roadbuilding holiday, regard the cost of highways as a price to be paid to *obtain* good roads, and not, as it truly is, an unending payment to *maintain* a highway transportation service. When this latter conception has replaced the former in the mind of the general public there will be less talk of roadbuilding holidays. Until the latter conception has been accepted it may be expected that the essential continuity and regularity of the processes of roadbuilding and maintenance will be interrupted periodically by changes—increases as well as reductions—in the provision of revenue. And, as between the feast and the famine, in point of their harmful effects, there is perhaps little to choose.

It is, therefore, the supreme duty of all who have intimate knowledge of the necessity of such regular provision for highway work to join in making it so widely understood that in the future there will be no possibility of ill-considered legislation, and arbitrary and unwise tampering with highway appropriations and revenue that in recent years have threatened the security of one of the nation's largest public investments. It is for the purpose of supplying the irrefutable facts that are necessary to counter the mass of prejudiced opinion of one shade or another upon which such disturbing actions are taken that the Bureau of Public Roads and thirty-nine state highway departments are now engaged in the most intensive studies of the highway situation yet undertaken. The central objective of these studies is the determination of the minimum continuing cost of maintaining a publicly desirable and physically adequate highway program through a future period as long as the limits of fallible foresight will permit. The minimum annual cost so to be determined will mark the danger line below which annual revenues will be reduced only at the known peril of tangible loss, and it will set a standard for the provision of tamper-proof resources for a conservative and business-like highway program,

to which, if wisdom prevails, the present undependable provisions will be adjusted.

If there is in all this an imperative ring it is not the presumptuous order of a special interest, but the undeniable demand of economic necessity, affecting the interest of the public as a whole in many ways.

Unavoidable maintenance

Simplest and best understood of these imperative needs of the highways is the need of maintenance. We have created an improved highway system that is subject daily to the wear and tear of ordinary usage by upwards of 26,000,000 motor vehicles, and beat upon steadily by natural forces that tend to destroy it. The need of a correspondingly constant maintenance activity to repair the damages thus caused has come to be generally appreciated and none but the least prudent now would risk the inevitable loss that would occur if there were any failure to provide the wherewithal to continue this stitch-in-time process.

With increase in the mileage of constructed roads and increase in the average age of the roads in use, the annual cost of maintenance tends to increase. The construction in recent years of a large mileage of the lighter and less costly types of surfaces is also reflected in greater maintenance liability. In consequence, a given total of annual expenditure, after deduction of the essential maintenance reserve, leaves less and less for construction; and any reduction of the total appropriation means still further curtailment of the construction program.

Although it is not generally understood, such reductions in the funds available for construction, causing temporary cessation or even reduction of construction activity below a certain minimum rate, are also productive of inevitable loss. This is true for the following reasons.

Imperative reconstruction

The improved roads that now exist have all of them been built within a period of 30 years or more. These roads, all of them, within the next 30 years will have to be reconstructed. Some of the less durable types will doubtless require partial reconstruction several times within such a period; and as, year after year, the originally constructed mileage grew, so, year after year, that mileage will come to the need of reconstruction. In the initial improvement of many of these roads the work done was deliberately limited. A result was accepted that was known at the time to be less than would ultimately be required for completely satisfactory service of the traffic, with the definite intention of adding to the improvement at a later date as need should develop and funds for the purpose materialize. This is the policy of stage construction, well established and entirely reasonable. It was justified by two circumstances that have surrounded the work of road improvement during the pioneer period now closing.

First, there was the fact that while there was always the prospect of traffic growth, there was always the possibility of giving adequate temporary service with a degree of road improvement less than would ultimately be required.

And, second, there was the incentive and necessity to seize the possibility mentioned in order to extend to a maximum of mileage some degree of improvement as quickly as possible, with the limited annual funds the public could be induced to provide. The prime need was to "get the traffic through." When that was done it would be time enough to talk about refinement and elaboration of the improvement.

Let it be recorded here that no other course would have given us the improved mileage and the degree of road service we now have. But it did involve the deferment of construction obligations now reaching maturity.

There is now and will be henceforth a certain annual construction requirement on the roads already improved; a requirement to reconstruct as the original improvement wears out, and a requirement to complete the partial improvement originally made. These requirements must be met, else we suffer loss as direct and tangible as that which results from the neglect of maintenance. There is no possibility of reducing the amount of this absolutely necessary work. On the contrary, there is every reason to anticipate an increase, since in the annual amount of original construction there was a year-by-year increase.

In this unavoidable work of reconstruction and stage construction it will be necessary to do more than merely reestablish worn-out existing surfaces or upbuild them to greater strength and adequacy. Without concurrence in a recently published pessimistic appraisal of the value of the best past efforts of road builders—an appraisal that must be regarded as less fortunate in its attainment of accuracy than in its sponsorship—it is possible to see that there have occurred in the last few years great changes in the performance ability of motor vehicles. It is impossible to neglect the obligation that these changes impose to correct pioneer highway alignment, to widen pioneer surfaces, to increase sight distances, separate traffic lanes, reduce grades and to do whatever else may be needed to make the highways amply safe for modern usage.

Undeniable new improvements

All of which means that, without adding by so much as a single mile to our present mileage of improved roads, there will be need of a construction and maintenance activity in the future at least as great as that which characterized the period just preceding the depression. An unremitting, never-ending activity, it will have to be, that can be shirked or reduced only at the cost of direct, tangible loss by depreciation of the existing highway plant, to say nothing at all of the even greater, but less

Farmers who would bring the advantages of the paved primary roads to their doors are not receptive to the idea of a road-building holiday. By opening up secondary roads to motor vehicles by improvements of a temporary nature they add to the demand for better and more permanent construction.

MAINTENANCE of roads already built would automatically add to the work of state highway departments even though a holiday were declared on new construction.

tangible losses involved in the decline in adequacy of service to the traffic.

And—most assuredly—we have not yet built our last mile of highway. Few, even of the would-be holiday makers, believe that we have.

Our surfaced roads now total somewhat over a million miles. We have thought of our total road mileage as, in round figures, 3,000,000. Both figures may be considerably altered by the measurements made in the planning surveys now in progress, but whatever the true figures prove to be, it is certain that a wide margin will be found between the total existing road mileage and the mileage thus far improved. In that margin there will doubtless be found a certain group of the remaining more useful secondary roads which, by even the narrowest test of utility, will merit improvement. How much beyond this point we should or will go into the improvement of less traveled land-serving roads for general economic and social reasons; how much the mileage of improved roads will be increased by future construction of roads that do not now exist at all, in response to the need of relief for now crowded main highways and the normal need of new roads to serve a growing and possibly redistributed rural population; how much of new mileage will be added in belt lines around cities and in parkways and special express highways: These are questions that the future will have to decide.

Summed up

That we shall continue to increase the total of improved road mileage, for several years, is a probability that no one in the least familiar with the economic need and public demand will deny. And every added mile means a permanent increase in the maintenance and reconstruction obligation created for the future—a permanent addition to the inescapable annual cost of the existing highway plant.

Proposals for a roadbuilding holiday, when they are not thoroughly dishonest and vicious, generally express the hope that highway expenditure may be reduced, temporarily or permanently, in order that revenues raised for road purposes may be diverted to other public uses. Whoever else the holiday may be intended to benefit, it rarely, if ever, holds prospect of relief for the payers of special motor vehicle and gasoline taxes.

From what has preceded it should be apparent that there can never be a permanent reduction of highway expenditure; that, on the contrary, an increase must be expected. It should be apparent also that even a temporary let-down can be indulged in only at the price of immediate loss, in consequence of highway depreciation, and increased future expenditure to make good such loss. In the regular and timely performance of needed and unavoidable work lies the one possibility of holding the cost of our highways to a minimum; and such regularity and timeliness can be achieved only when there is assurance of revenue in the required amount. In the dedication of motor vehicle revenues to highway purposes, is to be found the principal basis of efficient and effective state highway administration in the past, and the vice of current diversions of such revenues to other purposes is that they tend to destroy the essential proportionality of highway revenue to imperative highway needs. If it be conceded, as surely it must, that there is in any event no prospect of reduction of the special taxes of road users; and if, as this article endeavors to prove, there is an annual cost of highways that cannot be avoided—a cost that exceeds the total yield of road user taxes at their present rates; if these propositions be accepted, then there can be just one reasonable conclusion regarding the diversion of motor vehicle license fees and gasoline taxes from the highway uses for which they were originally imposed and to which they alone of all public imposts bear a relation of cause and effect. That conclusion is that such diversion is folly; nothing less.

Public the final arbiter

Lest it be mistakenly concluded, from the emphasiss that has been laid upon the inevitability of highway expenditure, that what shall be done upon and to the highways has somehow got beyond popular control, it should be added that this is not true at all. The public will, formed in the knowledge of public need, is still the final arbiter of highway policy. All that has been done to provide the means of more perfect highway transportation has been done in response to insistent public demand. Conflicting with every past proposal of a roadbuilding holiday, that demand has continued strong. It continues today in the face of willful diversions and withdrawals of the revenue needed to satisfy it—diversions and withdrawals approved in many cases by the very groups that most insistently demand increase of improved highway mileage and concomitant highway cost. The inconsistency is obvious. Like the average individual who is said, these days, to have two points of view—the pedestrian and the vehicular—the public also is apparently of two minds about the highways—of one mind in its desire for better highway service, and of another when it is asked to pay for what it wants.

Obviously this conflict of public desires must be reconciled. The nearer we approach the final limit of wise investment in the highways the more important does it become that the public be given a real opportunity to express its will on the basis of a full revelation of the two sides of the ledger.

It is such a revelation of the exact progress thus far attained in meeting the essential highway needs, of the further needs awaiting service, and of the permanently continuing cost of meeting the sum total of recognized needs, that the state-wide highway planning surveys aim to afford. These surveys will supply for the first time precise knowledge of the physical state of the entire rural highway system, of the degree of approach to complete improved highway service to rural and urban populations, of the volume and character of the vehicle movement over all parts of the highway system and the further highway improvements needed for the economical service of this traffic, of the present financial provision for the meeting of these needs, and of the probable ultimate cost of supplying a completely satisfactory and economically defensible highway service. Presenting both sides of the equation in terms as concrete as may be possible, and replac-

ing the inaccurate, conflicting and often prejudiced beliefs and assumptions that have served hitherto as the only available information, it is hoped that these surveys may form a foundation upon which may be erected a constant and enduring highway policy. Through them it is expected that it will be possible to present for public consideration the true and inescapable costs of the highways economically and socially desirable—the costs of these highways, to have and—as the wise old legal phrase continued—to hold. There is in that ancient verbiage a very salutary reminder that keeping is usually a lses lightsome affair than getting; and it is a reminder that can be heeded with profit in all future decisions respecting the highways. Giving it heed there may be less of holiday gaiety in embarking upon new and untested highway obligations and less thought of holiday respite in holding to those we undertake.

(Next week—Freeway at Intersections)

Concrete Silo Staves Used To Pave Peoria Streambed

Articulated mat of concrete blocks strung on wire cables paves a streambed with hand labor and little excavation

By Jacob A. Harman
Consulting Engineer, Peoria, Ill.

LINING A STREAMBED with concrete silo staves, strung on cable segments to form an articulated mat, is a feature of Peoria's $500,000 WPA force-account Woodruff Parkway and Dry Run Improvement project which will provide flood protection and needed neighborhood recreation area. It consists of straightening and bringing to uniform cross-section and lining 6,800 ft. of Dry Run Creek, installing sanitary and storm sewer connections and construction of two roadways along the stream.

In order to keep excavation to a minimum it was decided to bring the channel to a uniform cross-section, following the existing grade and alignment of the streambed. The cross-section is designed to insure self-cleaning velocities at low flow and take care of 3 in. per hr. maximum flood run-off. Bottom width is 9 ft. 2 in., rounded to a radius of 8.3 ft. The concrete lining extends up each bank at a slope of 1½ to 1. Then comes a 4 to 1 earth slope, topped by a 2 to 1 slope extending to natural ground. The gradient varies from 0.7 to 1.2 per cent and averages 0.85 per cent.

Segmental lining

In studying methods of paving the channel the idea was conceived of employing concrete segments woven into an articulated mat much like the revetment used with success along the Mississippi River. Various methods of building the segments were considered. The plan finally adopted was to lease the local plant and machinery of the Michigan Silo Co. during the winter months and build segments with silo stave forms. The forms were modified to provide for two ¾-in. parallel holes through the slabs for stringing connecting cable, and to provide rounded "hook" shaped edges that would lay tightly together and allow rotation of adjoining segments to fit the channel contour.

About 50,000 segments were manufactured, to a size of 12x30x2½ in., with holes located at the quarter points. A 1:2:4 mixture was used and segments were made on a vibrator to insure concrete of maximum strength and density. No reinforcement was used.

The mat was formed by laying pieces of ⅜-in. wire cable transversely across the excavated channel and stringing the segments on the cable. Transverse joints were staggered. About 60,000 ft. of cable was required. The units were easily handled by two men. The block laying crew followed immediately behind a gang which dressed and tamped the soil, to insure uniform bearing.

STRINGING THE "SILO STAVES" of concrete on two ⅜-in. wire cables running transversely across the excavated channel.

After a short period of experimentation and training, the relief crew developed a high degree of proficiency in dressing the channel and in weaving blocks together. A smooth channel section with tight joints was obtained.

The project was begun in November, 1935, and is scheduled for completion July, 1937. It has provided work for 250 to 300 relief workers.

LINING A STREAMBED in Peoria, Ill., with an articulated mat of concrete blocks assembled in the field.

Personnel

For the city of Peoria William Conrad is commissioner of public works, Charlotte S. Ashman is chairman of the city planning commission and L. D. Jeffries is city engineer. The writer, as consulting engineer, designed and is supervising the project which is under the immediate direction of E. O. Pearson, resident engineer. WPA work in this area is under James F. McElwee, director. C. W. Anderson is supervisor.

Vierendeel Girder Bridge Introduced In America

First bridge of this type, in which diagonals are omitted from the truss panels, will be built in Los Angeles. Seven others to be built later.

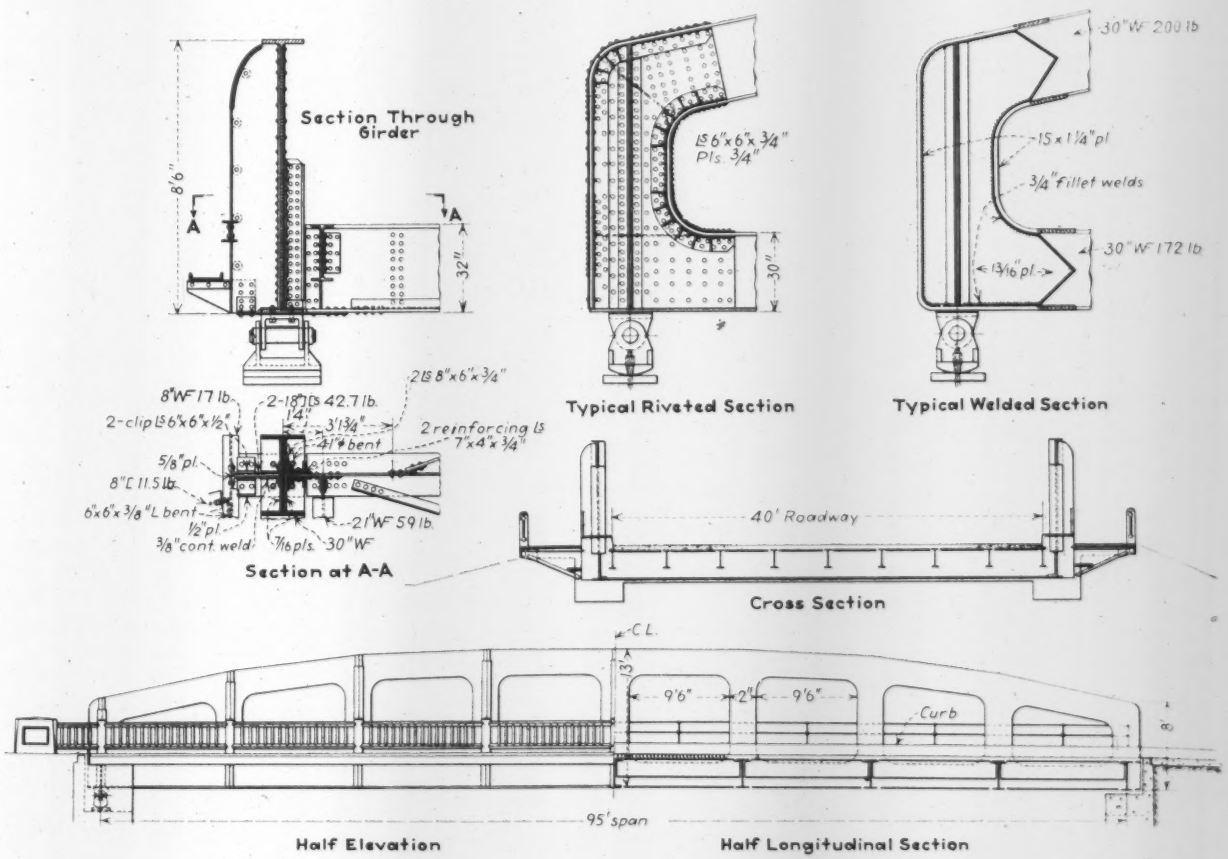
By L. T. Evans
Structural Engineer, Los Angeles, Calif.

A CONTRACT was let in July for the first of eight structural steel Vierendeel girder bridges which will span one of the channels of the Los Angeles County flood control project, now being carried out by the U. S. Army engineers. Bids were invited on both riveted and welded designs, and the award was made on the former. This is believed to be the first bridge of this type to be employed in this country, although such rigid panel trusses without diagonal members have been used extensively in Europe and particularly in Belgium, the country of their origin.

Since the Los Angeles bridge is to be built in a congested part of the city, many complications arose. The original channel was much narrower than the one selected for this improvement, so that the bridge span was increased from about 45 to 96 ft. Fixed channel and street grades limited the distance between road surface and the under line of span to about 3 ft., thereby eliminating a deck structure. Visibility was essential as side streets intersected very close to the ends of the bridge. The city officials objected to any overhead bracing or to the use of a middle support. In addition to these requirements, it was desirable to use a vertical end post high enough to mark clearly the beginning of the bridge, thereby eliminating an arch or inclined chord structure. After taking all of these factors into consideration, a Vierendeel girder was chosen, and an outline selected from a previous design made by the writer several years ago.

The analysis was made by the method of restraints, derived any published by the writer. Deformations due to thrust in the posts were neglected, but the effect of chord thrust was considered. Stresses due to differential temperature change were not included. The sections and connections of the members were designed for either riveted or arc welded construc-

Structural details of steel Vierendeel girder bridges to be built at Los Angeles. The riveted design has been adopted for the first of eight proposed bridges.



tion. An H-20 loading was used in the design.

In the accompanying drawing the elevation and longitudinal sections are self-explanatory and indicate the general arrangement. The detail showing the floorbeam connection has several interesting points. Since no top bracing was allowed, all lateral support for the top chord was obtained by a U-shaped system at each post. The vertical members of this lateral bracing are made up of two 18-in., 42.7 lb. channels, so connected that moment may be transferred to the floor beam. Channels were used in place of an I-section so that the sidewalk bracket rivets would be in double shear.

In developing connections for the stiffening channels capable of transferring the moment, the detailer was confronted by the presence of large stresses in the outstanding legs of the connection angles between the floorbeam and the post of the girder. In order to reinforce these connection angles, an additional pair of angles was included.

A typical joint detail is shown, for both riveted and the welded design. Estimates indicate that a properly planned welded girder would weigh about 80 per cent of that necessary if riveted joints are used. The method of shaping splice plates, etc. for the welded work is indicated.

For the railing the posts are of hollow cast steel, anchored at the base by angles which are bolted to the concrete. The rails are 3 in. hollow square steel tubing, and 1-in. hollow square steel tube spindals are electrically welded to the rails.

The bridge is a part of the flood control project being constructed by the Engineer Department, U. S. Army, in Los Angeles County, California, under Maj. Theodore Wyman, Jr., District Engineer. Capt. R. E. Cruse is chief of the engineering division. The writer is head of the structural design section.

Measuring Incinerator Performance By Residual Ash Analyses

Studies at Baltimore reveal that determination of combustible matter by weight in residual ash is a practical method by which guarantee rating can be specified

By Frank K. Duncan
Assistant Chief Engineer, Dept. of Public Works, Baltimore, Md.

AN INCINERATOR guarantee performance calling for the production of a residual ash with a combustible matter content not exceeding 7 per cent by weight was adopted by Baltimore following extensive tests to determine a practicable basis to insure specific performance. The new specification, superseding the original requirement which called for a mineral ash containing not more than one per cent of carbonaceous material, has proven highly satisfactory as a definite method of rating incinerator operation.

Incinerator privately operated

In January, 1933, a 600-ton incinerator was erected on city-owned property by a contractor who is to maintain and operate the plant at his expense until 1942. Under this arrangement the contract called for payments to the private operator of 80c. per ton for incinerating rubbish and $1.85 per ton for garbage. These unit prices include all expenses and amortization of the cost of the plant in ten years. The plant is the property of the city, and possession will be taken at the termination of the contract without any payments other than those stated.

The specifications, setting forth the essential features of the building and those governing the general design of the furnaces and appurtenances, were based mainly on certain specific requirements and performance. Included in the guarantees was the following clause:

> All materials, except incombustibles, placed in the furnaces shall be evaporated and incinerated to a mineral ash containing not more than one per cent of carbonaceous material by weight.

In reviewing the specifications of other cities, when we were drafting our specifications, it was found that the general practice was to specify a resulting mineral ash containing not more than one per cent of organic matter, exclusive of carbon. Organic matter, however, contains carbon; in fact, the definition of "organic" matter is "containing carbon as an essential ingredient." The amount of organic matter under such specifications has never, to our knowledge, been actually determined, as there are no known methods of analysis which can effect separation of organic matter from a mixture in which other materials containing carbon are present.

In high temperature incinerators, such as was specified in this instance, there is almost complete combustion of carbonaceous materials. Since there was the possibility that free carbon would escape from the chimneys in excess of the amounts permitted under the smoke guarantee which was not to exceed a degree of darkness or density greater than that determined by Chart No. 1 on the Ringelmann smoke scale, our specifications differed from those of other cities.

TABLE I—TYPICAL RESIDUAL ASH CALCULATION FROM ANALYTICAL DATA

	Total Content Per cent		Combustible, Content, Per cent		Total Combustible, Per cent
Large clinkers...	20.73	×	0.00	=	0.00000
Small clinkers...	17.08	×	5.55	=	0.94794
Fine ash.....	60.36	×	6.70	=	4.04412
Unburned matter	1.83	×	74.31	=	1.35987
	100.00				6.35193

TABLE II—ANALYSES OF RESIDUAL ASH AT THE REED BIRD AVE. INCINERATOR

Material	1933 Average, Per cent	1934 Average, Per cent	1935 Average, Per cent
Metals.....	2.73	2.55	5.38
Glass.....	10.90	11.05	16.51
Large clinkers.....	23.15	21.80	27.08
Small clinkers.....	18.40	16.07	14.43
Fine ash.....	44.22	48.22	36.57
Unburned matter.....	.60	.30	.03
Total combustible not including metals and glass.....	5.95	6.03	5.25

Determination method standardized

This change from an organic matter basis to the carbonaceous material determination was a step in the right direction. However, it did not go far enough. After the plant was placed in operation the residual ash apparently contained little or no organic matter and was free from offensive odors, but it was found impracticable to analyze and test the ash to determine whether it complied with the specifications.

A method of determing the percentage of combustible matter by weight was finally evolved by Conrad Zieget, Jr., chief of the standards bureau of the Department of Public Works. The determination was based on the fact that (1) the amount of combustible matter in residual ash of garbage alone should be less than the total combustibles in the ash of a mixture of garbage and rubbish and (2) that the various acids found in garbage are converted into carbonates at high temperature and this carbon is finally consumed to a mineral ash. With this in mind, when the determination calls for percentage of combustible matter, and such obviously incombustible

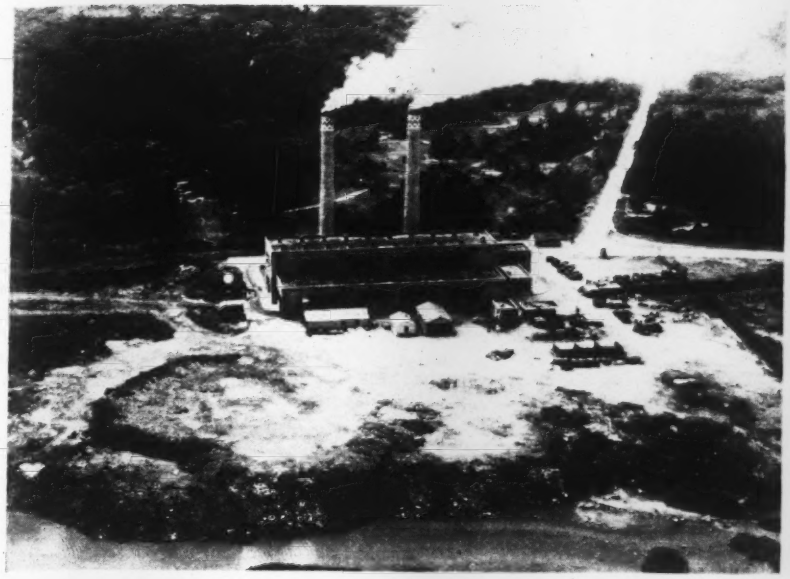


FIG. 1—MUNICIPAL INCINERATOR PLANT at Baltimore which was built and is operated by a private contractor under specifications calling for the production of an ash of specific mineral content. The ash is used for filling low ground around the plant.

materials as glass, metals, etc., are not considered as part of the original sample but are discarded, the percentage allowable under such conditions should be greater than 1 per cent.

As a result of these investigations it was agreed by the contractor and the city that a residual ash with combustible matter content not exceeding 7 per cent by weight was entirely satisfactory for placing on a dump, and that the specifications should therefore be changed to so indicate.

Sampling procedure

The following standard method of sampling at the plant, preparation of the "laboratory" sample, and determining the moisture and total combustible matter in residual ash was adopted.

Collection—Samples consisting of a shovelful of the ash withdrawn from each truckload removed, are regularly collected each day. From these samples all tin cans, pieces of metal, and other obviously incombustible materials are discarded.

The gross sample pile is thoroughly mixed by a continual working of the pile, shoveling it over and over and then selecting from it, by "quartering," a composite sample of about one cubic foot. This "quartering" consists of flattening down the point of the cone pile until the ash is of a uniform thickness; two lines are then drawn at right angles across the flattened cone and the two opposite quarters discarded. The remaining opposite quarters are shoveled into a separate cone, which is worked, flattened and quartered, again discarding two opposite quarters. Coning and quartering is continued successively until the amount has been reduced to about one cubic foot and this constitutes the "plant" samples.

Laboratory Preparation—The plant sample is brought to the laboratory and there it is spread on a large hot plate where it remains until all apparent moisture is removed. After cooling, it is hand picked and all paper, rags, match sticks, fruit-stones, fruit-seeds, unburned garbage and other apparently combustible material is segregated and weighed. This segregated portion is known as the "unburned matter." The remaining portion of the sample is again hand picked and all incombustible materials such as metals, glass, porcelain, etc., are removed and discarded. The balance of the sample is then screened on an 8-mesh sieve and that which passes through is called "fine ashes." The material retained is then screened on a quarter-inch sieve and the material passing through is called "small clinker," while the material retained is termed "large clinker." The "large clinker" usually is free of all combustible matter.

The fine ashes are then thoroughly mixed and quartered. One quarter of the sample is then ground finer so that about 80 per cent of it will pass a 100-mesh sieve. The latter is again thoroughly mixed and quartered to give a sample sufficient to fill a 6-oz. bottle. This sample is again ground so that about 80 per cent will pass a 200-mesh sieve. This is known as the "final fine ash" sample.

All of the small clinker is ground in like manner and a "final small clinker" sample is thus obtained which will show about 80 per cent passing a 200-mesh sieve. The "unburned matter" is similarly treated.

During these operations, the weights and percentages by weight are recorded for the fine ash, the small clinkers, the unburned matter, and the large clinkers.

On the samples of fine ash, small clinkers and unburned matter, moisture and total combustible matter determinations are made according to standard methods of analysis. These determinations are not made on the large clinkers, as they are considered free of all moisture and combustible matter.

Calculations—Knowing the percentages by weight of fine ash, small clinkers, unburned matter, and large clinkers, and having determined the total combustible matter content of the samples, then the total combustible matter of the residual ash can be calculated as shown in Table I.

Since August, 1933, when the changes in the specifications were made, the bureau of standards has taken samples of the ash and made 35 tests to April, 1936, showing the total per cent of combustible matter. The low test was 3.63 per cent and the high test 7.33 per cent. The average of all tests was 5.57 per cent. In Table II are shown average yearly analyses of residual ash.

Since these changes in the specifications and method of making tests of the ash have proven satisfactory in Baltimore, this article is written with the view of calling the matter to the attention of those who may be interested in clarifying and making specific the ash guarantees in future specifications for incinerators.

Talk of Vehicular Tunnel Under Alps Still Current

There is much talk in France about the possibility of a tunnel through the Saint Gothard mountains for automobile traffic through the Alps. The construction of a tunnel under Saint Gothard would bring Paris within 541 miles of Milan. There is likewise talk of a tunnel under Mount Blanc, which would bring Paris within 538 miles of Milan.

However, the high cost has caused some hesitation. It is estimated that a tunnel under Saint Gothard would cost about $33,000,000 for the 12 miles required. To cover expenses, it would be necessary to levy a toll of about $6.50 per automobile during the first year of completion of the tunnel. It is estimated that during the first year more than 100,000 vehicles would use the tunnel and that ten years later the number would have increased to about 320,000.

A less expensive method which has been suggested is to alter the tracks within the Simplon tunnel to permit passage of highway traffic. The change required, it is stated, would cost but a few hundred thousand dollars. However, the Swiss government has expressed opposition to this plan, believing that the expense of ventilating the tunnel would be higher than is generally believed and that that traffic would not be great enough to justify the expense (*ENR*, Aug. 27, 1936, p. 303).

New Cloudburst Flood Formula

A proposed discharge formula for limited areas that fits well with runoff records of phenomenal floods in this country and abroad

By I. Gutmann
Associate Editor, Engineering Index, New York, N. Y.

THE RECENT DESTRUCTION of the Zebrino Dam in Italy and of the Elk Creek Dam in Oklahoma forces us to recognize the reality of phenomenal cloudburst floods and to think of practical ways of providing against them. Of course cloudburst floods of this magnitude are extremely rare and in designing a dam we may choose to ignore them; still we have to know what we dare to ignore.

According to F. Pagliari, writing in *Annali dei Lavori Pubblici* of March, 1936, the Orba flood of August 1935 that destroyed the Zerbino Dam (near Molare and Ovada) and caused great loss of life, raged for eight hours, and the drainage area of 54.5 sq.mi. discharged at the rate of over 1,200 sec.-ft. per sq.mi. Some components of the watershed discharged at the rate of nearly 2,000 sec.-ft. per sq.mi.

Dr. Pagliari compiled a table of 13 phenomenal flood records of several watersheds on the Italian mainland and on the island of Sicily, ranging in area from 8 sq.mi. to 741 sq.mi. and in rate of discharge from 2,150 sec.-ft. per sq.mi. to 165 sec.-ft. per sq. mi., respectively. These records are included in the more comprehensive table given here. To seven of these records (one of them—Orba at Orbicella—has been plotted erroneously, or perhaps its tabular value is incorrect), Dr. Pagliari has fitted a curve expressed by the equation:

$$q = \frac{2{,}900}{90+A}$$

Where q is rate of discharge in cubic meters per second per square kilometer and A is the watershed area, in square kilometers.

Putting q in second-feet per square mile and A in square miles we get:

$$q = \frac{102{,}500}{34.8+A}$$

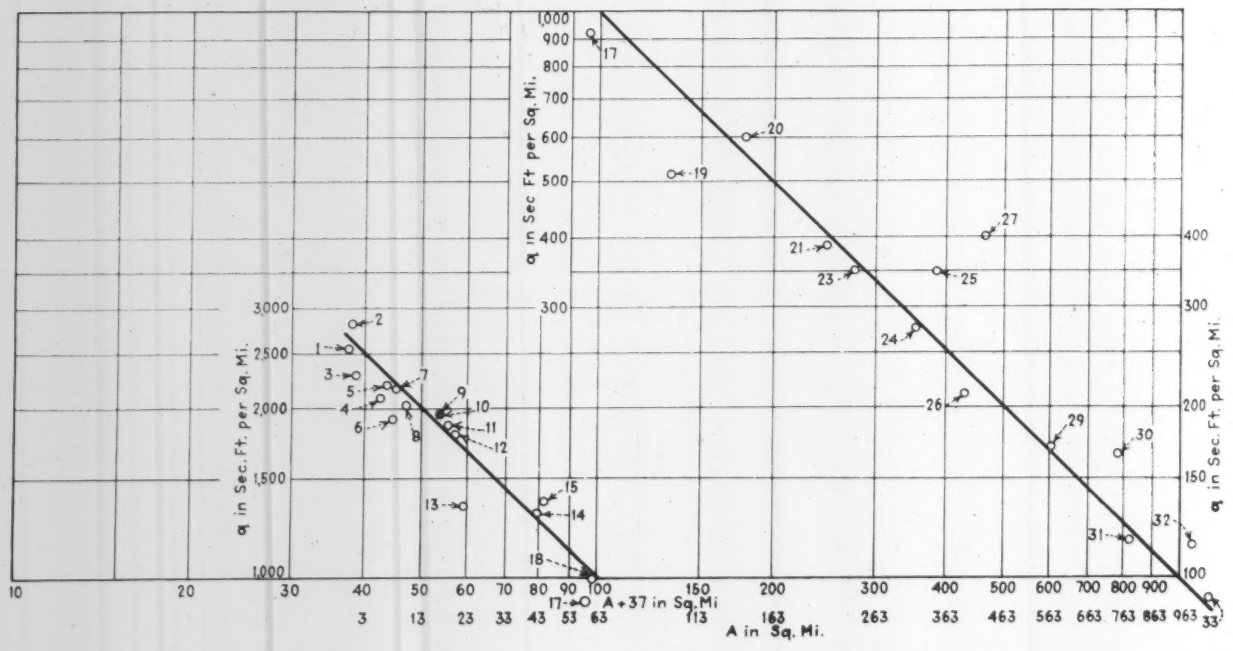
RECORDS OF CLOUDBURST FLOODS IN THE UNITED STATES, ITALY AND OTHER COUNTRIES

Stream and Watershed	Drainage Area in Sq. Mi.	Runoff in Sec. Ft. per Sq. Mi.	Date
1. Mann's Run, Creswell Sta., Pennsylvania	0.67	2,540	1914
2. Manoa Creek, E. Branch, Ohau, Hawaiian Islands	1.1	2,810	1921
3. Mad Creek, Le Roy, New York	1.5	2,300	1916
4. Kaneohe, Ohau, Hawaiian Islands	5.3	2,100	1921
5. Honey Creek, New Carlisle, Ohio	6.7	2,200	1920
6. Cameron Arroyo near Pueblo, Colorado	7.3	1,900	
7. Flumendosa at Bayn, Sicily	8.1	2,150	1930
8. Orbicella, Italy	10	2,010	1935
9. Orba at Olba, Italy	16.6	1,950	1935
10. Alazan Creek near San Antonio, Texas	16.9	1,950	1921
11. Orba at Martina, Italy	18.3	1,870	1935
12. Willow Creek, Oregon	20	1,800	1903
13. Cane Creek, North Carolina	22	1,340	1901
14. Orba at Valle Orbicella	42	1,300*	1935
15. Elkhorn Creek, West Virginia	44	1,363	1901
16. Sterza at Cecina, Italy	49	824	1930
17. Rock Creek, Pueblo, California	59	913	1921
18. Chester Creek, Pennsylvania	62	1,000	1843
19. Flumendosa at Anterabbas, Sicily	96.5	515	1930
20. Devil's Creek, Iowa (recomputed by H. P. Eddy)	143	600	1905
21. Uta at Ciceri, Italy	211	384	1929
22. T. Cecina at Ponteginori, Italy	235	257	1930
23. Cedrino at Cedrino, Italy	240	347	1930
24. Cecina at Monterufoli, Italy	315	275	1930
25. Khrishna, India	345	343	
26. Flumendosa at Ballao, Sicily	390	210	1930
27. Chagres River at Alhajuela, Panama	427	398	1909
28. San Catarina, Monterey, Mexico	544	590	1909
29. San Luis Rey, Oceanside, California	565	169	1916
30. Flumendosa at Villa Pitzu, Sicily	741	165	1930
31. Chagres River at Bohio, Panama	779	115.5	1910
32. Winooski River, Essex Junction, Vermont	1016	114	1927
33. Yuba River, Smartsville, California	1220	90.9	1909

*Plotted value.

The data on American streams have been quoted from *Transactions*, American Soc. of Civil Engineers, Vol. 85, 1922, those on Hawaiian streams from *Engineering News-Record*, Aug. 10, 1922, and those on Italian streams from *Annali dei Lavori Pubblici*, March, 1936.

THE RUNOFFS from rainfalls of cloudburst intensity show a straight line relation when plotted on logarithmic paper over a wide range of drainage areas.



The writer finds that by simplifying and modifying this formula to read $q = \frac{100,000}{37+A}$ (equivalent to $q = \frac{2,825}{96+A}$ in metric units), a better agreement with the Italian as well as with similar American records can be obtained. This formula is reminiscent of the Kuichling formula $q = \frac{35,000}{32+A} + 10$ (for watersheds less than 100 sq.mi., North American States) but it gives much higher values. In fact, for watersheds less than 200 sq.mi. it gives greater values than any formula proposed. A curve suggested by Gerard H. Matthes, in 1922, based on only five or six records, exceeds the writer's formula up to a drainage area of about 25 sq.mi., mainly because undue weight has been given to records of watersheds less than 1 sq.mi. in area. It gives lower values for the range of 25 sq.mi. to 60 sq.mi. A similar curve suggested about the same time by Harrison P. Eddy gives lower values up to about 15 sq.mi. and considerably higher ones between 15 sq.mi and 210 sq.mi. Both curves are inadequately supported and neither author offered a formula.

The formula $q = \frac{100,000}{37+A}$ representing a rectangular hyperbola was converted into a straight line, on the accompanying graph by plotting it on logarithmic paper, with log q as the ordinate and log $(37+A)$ as the abscissa. It is rather remarkable that the highest flood flows recorded in the United States plot closely to this line.

It is to be emphasized that we are dealing only with the very worst cloudbursts on record, the kind that produce a flow of 1,000 sec.-ft. per sq.mi. or more on watershed areas up to 60 sq.mi. The flood that destroyed the Lower Otay dam in Southern California, in 1916 and even the flood which lately washed out the Elk Creek dam in Oklahoma do not qualify for the "all-highest" category of cloudbursts considered here.

The proposed formula is primarily for watersheds from about 1 to 70 sq.mi. in area. (Four records for watersheds less than 1 sq.mi., ranging from about 2,500 to 5,600 sec.-ft. per sq.mi. have been avoided by the author. They appear unreliable probably on account of the large percentage error liable to occur in the determination of the area of a very small watershed.) But it can also be used for estimating phenomenal floods in watersheds as large as 350 or 400 sq.mi., as seen from the graph. Within this range the formula offers a satisfactory, generous estimate of cloudburst floods based on the world's worst experience so far. It probably represents the maximum maximorum of flood flows for this geological era and climatic age. For watersheds of 1,000 sq.mi. or more the formula will give values that are decidedly too low. On the other hand, a number of very high records of flood flow from watersheds 100 sq.mi. to about 1,300 sq.mi., such as the 1916 flood on San Luis Rey in California and the 1927 Winooski River flood, in Vermont, plot pretty closely to the curve $q = \frac{100,000}{37+A}$

It is worth noting that the magnitude of cloudburst floods is independent of climate and geographical location. The three highest records in the world, near the top of our table, exceeding 2,000 sec.-ft. per sq.mi., come respectively from wet Hawaii, humid Ohio and semi-arid Sicily whose climate is similar to that of California.

There is no doubt that in damming small watersheds in thickly populated districts some provision, be it skimpy, should be made for cloudburst floods. Their frequency may be once in a thousand years, yet one may strike tomorrow.

Simplified Analysis of Flow In Water Distribution Systems

Using the method of successive corrections to obtain a balance of head loss in all possible paths of travel the actual flow distribution in a water supply network can be quickly determined

By J. J. Doland
Prof. Civil Engineering, University of Illinois, Urbana, Ill.

THE LACK of an accurate and quickly applied method for computing the flow distribution and variation of head in various parts of a water supply system has been a serious drawback in determining the design characteristics of such systems. Pocedures which involve the use of electrical analogy methods, model studies, and in some cases merely hit-or-miss approximations have been tedious in application and quite often unsatisfactory in results. It is of considerable interest, therefore, to direct attention to the accompanying valuable method of analysis which offers a new approach to the rapid solution of all problems concerned with flow in networks of pipes. —EDITOR.

A METHOD for the solution of problems concerned with the distribution of flow in a network, heretofore solved only by expensive electrical analogy methods, has been developed by Hardy Cross, and was recently announced in Bulletin No. 286 published by the University of Ilinois Experiment Station. The application of this analysis to a waterworks grid system as described in this article by means of the illustrative example in Fig. 1, is a modification of the problem so ingeniously solved by Messrs. Camp and Hazen using the electric analogy (*Jour. N.E.W.W.A.* Dec. 1934).

Briefly the method consists of assembling the basic data in convenient form, on diagrams of the system; assuming any flow distribution; calculating flow corrections due to errors in the assumptions; applying the correction and repeating the procedure until the head loss between any two points by any possible path of travel is balanced.

Hazen and Williams formula, with C = 100, converted to the form $h = rQ^{1.85}$, where h is the head loss, r is the coefficient of resistance and Q is the discharge, is used in the solution of the illustrative problem shown in Figs. 1, 2, 3 and 4. The coefficient r is determined by the size, length, and roughness of the pipe and may be readily computed by use of Table 1.

The flow correction is calculated by dividing the error in the head loss in each circuit by $1.85\ \Sigma rQ^{0.85}$ for that circuit. The error in the head loss is determined as follows: First calculate the loss of head due to the assumed flows which are clockwise in direction. Next,

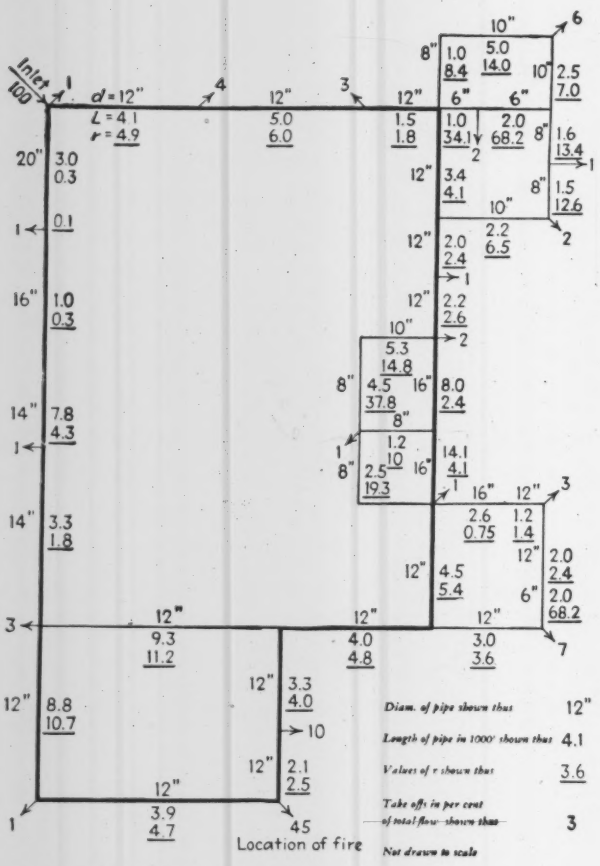

Inlet
100
d = 12"
L = 4.1
r = 4.9
Location of fire
Diam. of pipe shown thus 12"
Length of pipe in 1000' shown thus 4.1
Values of r shown thus 3.6
Take offs in per cent of total flow shown thus 3
Not drawn to scale

Fig. 1—Distribution System Layout

TABLE I—VALUES OF R FOR 1,000 FT. OF PIPE BASED ON HAZEN AND WILLIAMS FORMULA

head loss in ft. = $r \times 10^{-5} \times Q^{1.85}$ per 1,000 ft. (Q representing g.p.m.

d	c = 90	c = 100	c = 110	c = 120	c = 130	c = 140
4"	340	246	206	176	151	135
6"	47.1	34.1	28.6	24.3	21.0	18.7
8"	11.1	8.4	7.0	6.0	5.2	4.6
10"	3.7	2.8	2.3	2.0	1.7	1.5
12"	1.6	1.2	1.0	0.85	0.74	0.65
14"	0.72	0.55	0.46	0.39	0.34	0.30
16"	0.38	0.29	0.24	0.21	0.18	0.15
18"	0.21	0.16	0.13	0.11	0.10	0.09
20"	0.13	0.10	0.08	0.07	0.06	0.05
24"	0.052	0.04	0.03	0.03	0.02	0.02
30"	0.017	0.013	0.011	0.009	0.008	0.007

Example: r for 12-in. pipe, 4,000 ft. long, c = 100, is 1.2x4.0 = 4.8.

TABLE II—VALUES OF THE 0.85 POWER OF NUMBERS

N	0	1	2	3	4	5	6	7	8	9
0	0	1.0	1.8	2.5	3.2	3.9	4.6	5.2	5.9	6.5
10	7.1	7.7	8.3	8.9	9.5	10.0	10.6	11.1	11.6	12.2
20	12.8	13.3	13.8	14.4	14.9	15.4	15.9	16.4	16.9	17.5
30	18.0	18.5	19.0	19.5	20.0	20.5	21.0	21.5	22.0	22.5
40	23.0	23.4	23.9	24.3	24.8	25.3	25.8	26.3	26.8	27.3
50	27.8	28.2	28.7	29.1	29.6	30.0	30.5	31.0	31.4	31.9
60	32.4	32.9	33.3	33.8	34.2	34.7	35.1	35.6	36.0	36.5
70	37.0	37.4	37.9	38.3	38.7	39.1	39.6	40.0	40.5	41.0
80	41.5	42.0	42.4	42.8	43.3	43.7	44.1	44.5	45.0	45.4
90	45.8	46.3	46.7	47.1	47.6	48.0	48.4	48.8	49.2	49.6

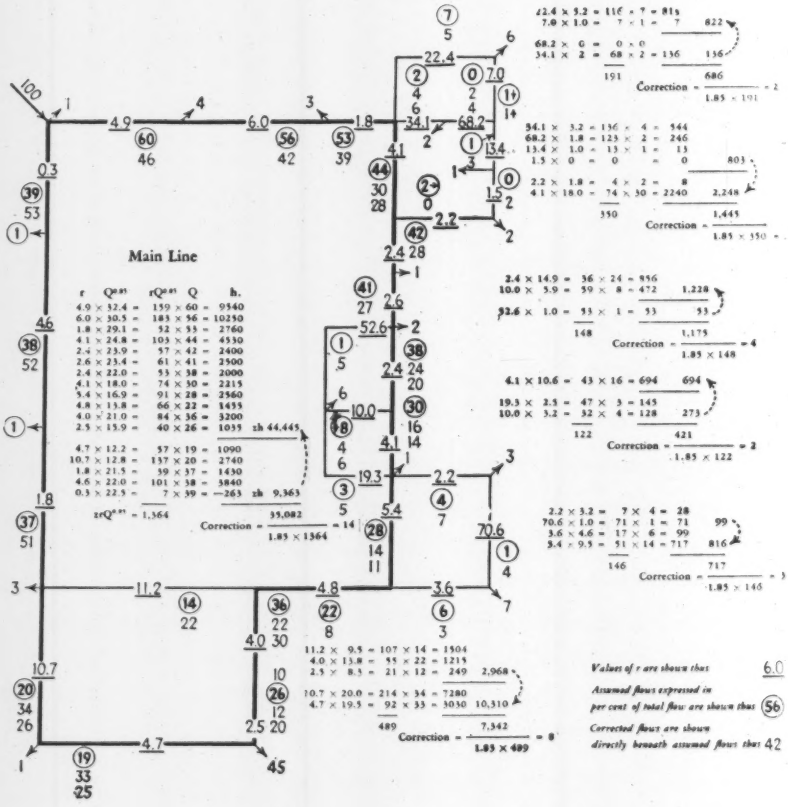
calculate the loss of head due to assumed flows which are counter-clockwise. The arithmetic difference of these totals gives the error in head loss. The value of $\Sigma rQ^{1.85}$ is computed for the entire circuit being studied and the summation is made without reference to sign. Values of the 0.85 powers of numbers from 0 to 99 are given in Table 2.

Figs. 2, 3, and 4 show the successive corrections for the several circuits of the illustrative example. The arrows placed at the right of the calculations and pointing from the smaller to the larger value of the head loss, Σh, indicate the direction of the flow correction in each circuit. The flow correction is added to or subtracted from the assumed flow depending upon whether its direction is the same or opposite to that of the assumed flow. The corrected flow is then placed on a new diagram and the procedure is repeated until the head loss, for clockwise and counter-clockwise flows, is balanced within any desired limit of error. It is rarely necessary in waterworks problems to apply more than three corrections.

The appearance of three flow figures on pipes common to two circuits (see Fig. 2) is caused by the use of corrected flows of one circuit for computing the correction in adjacent circuits.

After the circuits are balanced to

FIG. 2—First Correction


Main Line
Values of r are shown thus 6.0
Assumed flows expressed in per cent of total flow are shown thus (56)
Corrected flows are shown directly beneath assumed flows thus 42

within an allowable error, the loss of head in feet between any two points may be calculated by multiplying the sum of the h values between the points by [(0.01 total flow in gal. per min.)$^{1.85}$ divided by 100,000],

$$\frac{\Sigma h}{100{,}000} \times (9\,\text{pm})^{1.85}$$

This makes it a relatively simple matter to construct a pressure contour map of the system. Multiple sources of supply and elevated storage may also be included in the study by this method.

The circuits may be calculated in any order desired and any direction of flow may be assumed. If the latter is in error the counterbalancing flow or flow correction will correct it. The flow correction will also eliminate accidental errors in calculations provided they are not persistently made. It is quite important, however, that the total assumed inflow and outflow at any junction be balanced. Minor losses of head have been neglected in the solution presented.

Figs. 2, 3, and 4 show all calculations for the complete solution of this problem. It is hoped that the figures will make the application of the method clear. All calculations were made by slide rule; only one setting is used in computing $r \times Q^{1.85} \times Q$. Since only whole numbers were recorded, this accounts for apparent discrepancies in multiplication. About four hours were required for the solution. The method may be applied for design purposes and it is particularly well adapted to the investigation of existing systems under different operating conditions.

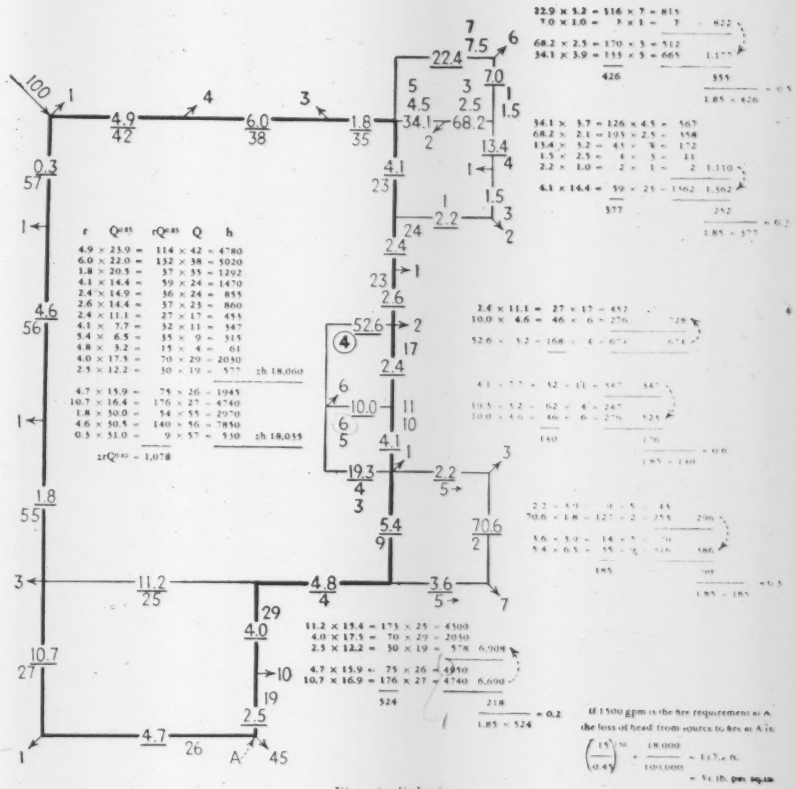
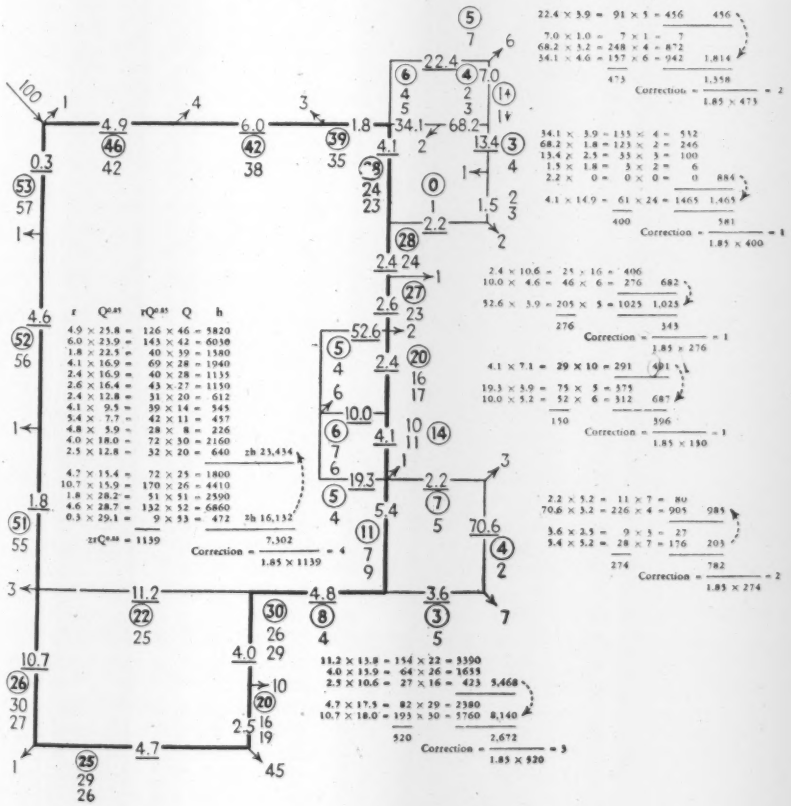


Fig. 4—Solution

Fig. 3—Second Correction



THE FOUR DIAGRAMS on these two pages illustrate the computations required to apply the Cross* analysis to flow distribution in pipe networks. The counterbalancing flow or flow correction is calculated by the formula, $\frac{\Sigma rQ^n}{\Sigma nrQ^{(n-1)}}$ or in this example, $\frac{\Sigma rQ^{1.85}}{\Sigma 1.85 rQ^{0.85}}$. The value of ΣrQ^n is equal to the difference in the head loss between two points in a circuit by two different paths. The value of $\Sigma nrQ^{(n-1)}$ is calculated for all pipes and assumed flows in the circuit without reference to direction of flow or to paths of flow. The direction of the counterbalancing flow will be correctly determined by an arrow placed at the right of the calculations and pointing from the smaller to the larger value of the head loss provided clockwise flows are calculated in a position above the calculations for counter-clockwise flows.

Soil and Water Conservation

Upstream Engineering Conference in Washington discusses many subjects related to the conservation of soil and water at the headwaters of rivers—Lack of adequate engineering condemned

THE KEYNOTE SPEECH of the Upstream Engineering Conference held in Washington Sept. 22-23, came near the close of the meeting rather than at the opening session and was made by Morris L. Cooke, the prime mover in organizing the conference. Up to that time papers and discussions had wandered, seemingly without definite aim, over many elements of land and water conservation, including hydrology, forestry, erosion control, soil conservation, wild life culture and mosquito eradication. But Mr. Cooke gathered the loose ends together in such a way as to give those in attendance the definite impression that the purpose of the conference was to obtain wider recognition of the interdependence of soil conservation and water conservation and use.

Mr. Cooke sees national welfare at stake due to waste of soil and to improper use and control of our water resources. This menace to the United States, he said, "is a complex problem created largely by uses of land and water in many places in a manner not warranted by basic physical conditions. It has various aspects: an appalling rate of soil erosion; minor and major floods; low dry-season streamflow, pollution of lakes and streams; inadequacy of clean water supplies; diminution of the groundwater store; and failure to use waters to greater social advantage as they flow to the sea. I desire simply to focus attention on the unity in physical and functional relationships, and on the necessity for an integrated engineering attack on the soil-water conservation problem."

The term upstream engineering is perhaps unusual, said Mr. Cooke, "but it has the virtue for that very reason of attracting attention to a composite field of engineering for which there has been insufficient regard in the United States. Not that the field has been entirely neglected. One sector of it—that lying immediately on farms where agricultural operations are conducted—has been given serious study for years by federal and state agencies having to do with drainage, irrigation, agricultural practices and, more recently, soil conservation. Another sector, forestry, has been given noteworthy attention especially during the last 30 years. But these activities generally, because of lack of public interest and insufficient support, have been too limited in scope, have not been sufficiently integrated, and have not been related to trunk-stream engineering.

"Of course trunk-stream engineering, in connection with the design of such works as dams and reservoirs, makes as thorough a study as records permit of the precipitation and runoff characteristic of the drainage area involved. The conditions back in the headwaters area have generally been accepted as indicated by the data, as acts of God. Such engineering has not yet, except in a few very recent instances, gone far enough to inquire seriously whether numerous acts of man modifying original natural conditions may not be responsible in large measure for the characteristics discovered."

Watershed moderators

Mr. Cooke went on to point out that this condition has come about through our consideration of each project as a thing in itself but stated that if the maximum human welfare is our objective there should be an integration of the engineering of an entire area. How this was to be accomplished might lie in the use of state compacts, possibly through state and regional planning boards, or possibly in counterparts of the Tennessee Valley Authority. "I suggest," he added, "that there should be a democratically chosen moderator for every watershed, a moderator for the Mississippi Valley as a whole, a moderator for the valley of the Missouri, for the Yellowstone and Big Horn. It would be better that these appointees should not have any authority in the legal sense, but that they should represent the citizenry of the watershed in advancing the conservation both of water and of soil."

Many interests represented

About 500 were registered as in attendance at the conference, half coming chiefly from the 30 federal agencies that cooperated in organizing the conference and the remainder coming from outside the city.

The conference opened with the presentation of a paper on the basic principles of water behavior prepared by Thornlike Saville, dean of the college of engineering at New York University, and presented by Prof. Harlan H. Barrows of the University of Chicago. Professor Saville's paper was fundamentally a plea for approaching the problem of soil and water conservation from a truly scientific viewpoint, for extensive research to obtain a quantitative answer to the many hydrologic questions involved, and for a true economic approach to the solution of the problem after the basic data has been obtained.

Professor Saville said that it is quite possible in designing a water conservation structure such as a reservoir to determine within a very small percentage of error what magnitude of flood it will hold, what it will do for low-water control, what it can produce in water power. But when we come to headwater land and water conservation, to upstream engineering, we enter a far more hypothetical realm. We do not know as yet the basic elements of the hydrologic cycles nor their interrelationships. We need many more rain gages, stream gages, snow surveys, evaporation pans, transpiration and infiltration measurements. But even the thousands of new stations recommended by the Water Resources Committee will not provide the detailed data requisite for quantitative evaluation of upstream engineering practices.

"It makes no difference how justifiable a land conservation program may be *per se;* that is, no matter how well warranted soil erosion measures, check dams, vegetative cover, reforestation, improved agricultural practices, may be from a land conservation standpoint, it does not necessarily follow that these same measures may be justified in the same degree or even in much lesser degree from a water conservation standpoint. If there is inadequate precipitation, no amount of land improvement can make any more. In some soils, and under some conditions, the land improvement may be highly beneficial to water conservation. Under other conditions, little benefit to water conservation may result. The relationship between the two depends upon knowledge of hydrologic cycles. Upstream engineering, if reasonably effective, is likely to be costly. The results in many cases will be worth the expenditure, in some cases they will not. The relationship between the elements of the hydrologic cycle, between land conservation and water conservation, and the benefits to be expected from the improvements all rest on facts which ought to

be determined in a scientific manner."

Many of the views expressed by Professor Saville were endorsed by Isaiah Bowman, president of Johns Hopkins University, in his paper on the influence of vegetation on land-water relationships. Vegetative cover is one of the few elements affecting water that man can control, said Dr. Bowman, hence all concerned should cooperate in seeing that it is controlled to the best advantage. Each watershed should be treated as a whole, not divided between upstream and downstream engineering, and future research should concern itself with determining locally unique conditions affecting that watershed. In all this work, he said, science should always be guided by practical considerations of cost.

Commenting on Professor Saville's paper, William Peterson of Utah State Agricultural College supported his views as to the need for much more complete information on the subject of rainfall and runoff. It is, he said, the small storms of great intensity that are the controlling element in all studies of small drainage areas. He urged that in building up our hydrologic records we obtain *rate* as well as *amount* of rainfall.

Additional comment on Professor Saville's paper was made by Leroy K. Sherman, consulting engineer, Chicago. Mr. Sherman said that Professor Saville has laid down a course we must follow in preparing to conserve the water and soil resources of the country, that we must have adequate data to prove that our solutions of our problems are correct before we go ahead with the scheme. He said further that engineers owe it to the federal agencies who have looked to them for research into the water conservation problems not to let the ill-advised enthusiastic promoter put their research to naught.

Soil erosion studies

Information as to the per cent of runoff from various soils and with various kinds of vegetative covers developed by the Soil Erosion Service was presented by Walter C. Lowdermilk. Mr. Lowdermilk emphasized the fact that while vegetative cover may have an important effect on the runoff from a small area, its importance decreases as the area increases. He added that even in the small areas vegetative cover is but one of many factors affecting streamflow and that unless all factors are considered error is bound to occur.

First upstream engineers

Beavers, said Earle H. Clapp, acting chief of the U. S. Forest Service, were the first upstream engineers. They built dams such as "college-trained engineers in the C. C. C. are trying to build." Mr. Clapp went on to say that although beavers were troublesome when uncontrolled, it might be found that they would be very useful in doing at almost no cost what is now being attempted at considerable cost and often with much less efficient structures. Before the coming of the white man, beavers could be found over a large part of this country and they could be brought back with proper protection.

Mr. Clapp said that the capacity of the earth's mantle to absorb water depends upon the condition of the plant cover, but that it is a mistake to assume that the plant cover can completely control the runoff.

Erosion losses

H. H. Bennett, chief of the Soil Conservation Service, summarized the information collected by his department as to the losses of agricultural land due to erosion and gave a large amount of information concerning the methods of erosion control developed by the Department. In summing up the work of his department he said that the agricultural specialists are not proposing a substitute for flood-water fortification downstream but are offering what they consider upstream reinforcement to downstream operations by conservation work on the land where floods begin and where silt loads are picked up. The immediate task ahead, he said, is to agree upon a simple procedure of cooperation and coordination whereby the engineer and the agriculturist will be working and thinking and planning along the same lines and for a common purpose.

Commenting on Mr. Bennett's paper, Noble Clark of the Agricultural Experiment Station at the University of Wisconsin, said that what is needed in soil conservation work is a determination of the stage at which government aid should be granted or, in other words, how far the owner should be expected to go on his own initiative and at his own expense. Some inducement or compulsion is necessary to get the land owners to do their own share. Prevention is cheaper than cure, he said, hence we need legal means to foster erosion control, such as reducing the taxes on land where the principles of soil erosion control are being put into practice.

Two types of flood control

Speaking at the dinner meeting of the conference, Major General Edward M. Markham, Chief of Engineers, said that regardless of what we do at the headwaters we still must have protection against flood flows along the channels of the larger rivers. A clear distinction must be made between flood control on little rivers and on large rivers, said General Markham. Storage reservoirs at the headwaters can never be expected to eliminate floods on the lower reaches of such rivers as the Mississippi, and it is apparent that on large rivers levees are a better protection against floods than remote reservoirs.

General Markham cited the benefits already obtained on the Winooski River in Vermont from the use of flood retention reservoirs of large capacity and pointed out that similar protection on the lower reaches of that river could not have been obtained through the use of a multitude of little ponds at the headwaters.

An international flavor was given to the discussion by Inspector-General M. Magnein of the Bureau of Water and Forests of France, who told the dinner meeting of work done in France to check the destructive effects of erosion at the headwaters of French rivers.

Surface runoff control

Robert E. Horton, consulting engineer, Voorheesville, N. Y., opened the second day's sessions with a long and carefully prepared discussion of surface runoff and the relation of surface runoff to groundwater storage. A large part of the paper was devoted to an explanation of the infiltration theory of surface runoff, a theory developed by him over the past few years. It is based primarily on the proposition that total surface runoff in any storm equals the total rainfall minus total infiltration. Long rains reduce the infiltration capacity to a minimum, and once it has been reduced to a minimum the rate of infiltration is unaffected by the intensity of the rainfall, hence the maintenance of a high infiltration capacity is one of the important tasks of those who would reduce surface runoff and increase the underground storage.

In concluding the presentation of his paper, Mr. Horton added his voice to those who already had urged that whatever is done toward the conservation of water through works at the headwaters be based on hydrologic principles and on sound economics.

Weather cycles

In any study of upstream areas, said Walter N. White, senior hydraulic engineer of the U. S. Geological Survey, recognition must be given to weather cycles to determine whether the area is passing through a wet or dry period, otherwise erroneous conclusions will be drawn as to what should be done to correct conditions on the stream under consideration. In this connection he pointed out that much of the lowering of the water table that is now giving concern is due to the fact that much of the country is passing through a dry cycle.

Mr. White said that check dams are of no value in increasing groundwater in some areas and that the amount of water that can be added by artificial

means to the groundwater supply is necessarily very small in relation to that which comes through natural processes. Recharge by water spreading is of value if properly handled in areas where it can be used to supplement natural processes. In streams with sandy bottoms the natural scouring that occurs during floods keeps the sand free of sediment and so permits a large amount of water to be added to the underground supply. This natural process of cleaning must not be interfered with by the construction of check dams that will cover the bottom with sediment.

Farm ponds in Kansas

George S. Knapp, engineer of water conservation, Kansas State Board of Agriculture, outlined what Kansas has done and is doing in promoting the storage of water in a large number of small farm ponds. Kansas, he said, was early among the states to recognize the need of such storage and passed a law reducing the assessed value of land a specified amount depending on the number and character of dams built. As now modified the law has resulted in the construction of 2,287 dams large enough to call for state supervision. The state looks forward to the construction of 50,000 of such small reservoirs. The reservoirs already built demonstrated their value in the drought of the past summer. However, Mr. Knapp pointed out that such reservoirs will not measurably reduce major floods. Kansas has laid out a complete reservoir program including farm ponds, recreational lakes, water supply reservoirs and large flood retention reservoirs.

Use of small dams

George D. Clyde, dean of the School of Engineering at Utah State Agricultural College, speaking on the subject of the control and use of small streams, said that every stream is a law unto itself and must be so recognized in plans for the conservation of its waters. This is especially true, he said, as between streams east of the 100th meridian and those farther west. On western streams, for example, headwater operations that reduce the low flow of the stream are detrimental, and if they hold back and put underground flood waters that are caught farther downstream and held for irrigation they immediately result in conflict between those who use the surface flow and those who draw on the underground supply.

Safe construction demanded

Professor Clyde laid special stress on the need for sound engineering in the construction of small dams at headwaters due to the risk involved through the failure of one dam starting the progressive failure of others below. He said further that properly constructed, check dams are expensive and should be used only where absolutely necessary. There have been too many failures of check dams in the present program and too many of the dams appear to have been built simply to make a showing.

Professor Clyde looks upon terrace trenches as important in plans for checking erosion. Such trenches delay runoff and make a seed bed for grass cover. He described the terrace trench system now used by the U. S. Forest Service. The method is expensive and can be used only on permeable soil. It should not be used on clay soils lying over rock where landslides may develop.

"Dry lakes"

Many of the ponds built for the storage of water as part of the present soil and water conservation program were characterized as dry lakes by Edward R. Jones of the Department of Agricultural Engineering, University of Wisconsin. These ponds, he said, are full of water during wet seasons when they are not needed but are dry when they are most needed. Professor Jones was very critical of the porous dams now being built in gullies as part of the soil erosion program. He characterized such dams as worse than useless as they only delay gullying temporarily and in the end result in worse gullies. The only dam that is satisfactory for such purposes is a permanent structure having an adequate spillway and an apron that will protect its toe from being undercut. Also, the channel below must be a stable channel. The purpose of such structures is to concentrate the fall and kill the energy of the fall.

Abel Wolman, chairman of the Water Resources Committee of the National Resources Committee, also was critical of some of the emergency work now being carried out. For lack of adequate engineering, he said, some of the storage dams now being built are potential sources of danger. Also, others already have "failed hydrologically." He re-emphasized the statement made by Dean Clyde to the effect that adequate engineering must not be abandoned in efforts to make a showing.

Mr. Wolman said that if this conference does nothing else it serves to emphasize that upstream engineering does not differ from downstream engineering, that a watershed must not be divided into parts but must be considered as a whole.

Small dams and floods

Sherman M. Woodward, water control planning engineer, Tennessee Valley Authority, pointed out some of the disadvantages of small reservoirs as compared with large reservoirs in flood control operations and the danger involved in poorly constructed small dams. Small reservoirs, he said, scattered on small streams can control floods only when their combined useful capacity equals or exceeds that required for large reservoirs on the main stream. Small reservoirs on the headwaters afford no control for the large amount of downstream runoff.

"The proper timing of the emptying and filling of a multitude of small reservoirs to control floods at distant points during excessive storms sweeping over a great river system is beyond human limitation. The failure of one small dam, cheaply constructed and inadequately safeguarded, on the headwaters of a small stream might start a succession of failures on similar dams immediately downstream with resulting greatly aggravated flood conditions. The cost of adequate flood control by means of small reservoirs would be many times that of a relatively small number of larger reservoirs on main streams and principal tributaries. Dams on small streams receive silt deposits at a greater rate per square mile of watershed than dams on larger watersheds. The useful life of small dams is short compared to large dams."

Malaria control

Mr. Woodward also pointed out that the construction of a multitude of small reservoirs may result in serious outbreaks of malaria. Also, on small reservoirs, the cost of mosquito control is more per acre-ft. of storage than on large ones because of the greater proportion of shoreline and shallow water and the difficulty of organizing and maintaining a trained patrol for small widely scattered reservoirs. The cost of malaria control, said Mr. Woodward, is the largest item of annual expense in the operation of water control projects of the Tennessee Valley Authority.

Administrative problems

The views expressed by Morris L. Cooke as to the need for a comprehensive view of our water and soil conservation problems were endorsed by Prof. Harlan H. Barrows at the closing session of the conference, but Professor Barrows questioned the practicability of Mr. Cooke's proposal to set up moderators for each watershed. He could not see that such a plan was possible when watersheds cross state lines. If the appointment of a moderator is to be non-political, he said, who would make it, and if elective, how could we be sure that the appointee was someone having a broad knoweldge of water problems. In closing, he said "As Mr. Cooke suggests, let us try to acquire greater vision but let us not, at the same time, become too visionary."

Symposium on Floods Features N.E.W.W.A. Meeting

Public health aspects and hydrology of the 1936 floods received major attention at four-day convention in New York City devoted to water works problems.

THE RESPONSIBILITIES and importance of maintaining water supplies in emergencies, such as occurred during the severe floods this past spring, were emphasized in a technical program presented at the 55th annual convention of the New England Water Works Association in New York City, Sept. 22-25. The registration at the meeting included more than 700 members and guests; manufacturers' exhibits numbering sixty-four represented a 50 per cent gain over last year. A special feature on the program was an address by Harold J. F. Gourley, past president, Institution of Water Engineers, and consulting engineer of London, England, who came by invitation of the executive committee of the N.E.W.W.A. as the representative of British engineers, to foster wider exchange of ideas and methods of waterworks practice between Great Britain and the United States.

Honorary membership in the association was extended to Thaddeus Merriman, who for many years was associated with J. Waldo Smith, in the development of the New York City water system and who later became chief engineer of the Board of Water Supply, the position from which he resigned in 1933 in order to devote all his time to consulting practice. The Dexter Brackett Memorial Medal, awarded each year for the most meritorious publication in the association's journal, was presented to Elwood L. Bean, chemist of the Scituate Reservoir Division, for his paper on "Providence Water Treatment."

Flood symposium

One entire technical session in which eight papers were presented was devoted to a symposium on the 1936 floods in the northeastern United States. In discussing the preparedness of public health authorities to cope with the hazards created by flood and water supplies, it was generally agreed that local officials were the key men in these emergencies. Although state health departments are the logical headquarters for coordinating all efforts in disasters where failure of water supplies and sanitary facilities may lead to disease epidemics, responsibility for prompt and effective action in stricken areas was felt to be that of the local waterworks operators and health officers. A. F. Dappert, assistant engineer of the New York state department of health, in reviewing experiences of the 1935 and 1936 floods, pointed out the importance of carrying on an educational program that would train local officials in responding to emergencies.

Prompt mobilization of all available facilities and the splendid cooperation of municipal, state and federal agencies were credited by W. L. Stevenson, chief engineer of the state health department, with saving the flood-stricken regions of Pennsylvania from an outbreak of disease epidemic. Although the floods adversely affected public waterworks supplying 200 communities and about 2,000,000 people, there were only four to six cases of typhoid traced as even indirectly connected with the inundation. The engineering division of the department had 281 persons on duty and three mobile laboratories were specially equipped and manned for bacteriological analysis of drinking water. The universal and insistent use of "boil water" warnings was held to be a substantial factor in the prevention of disease.

Flood stimulates reform

Arthur D. Weston, chief engineer of the Massachusetts department of health, pointed out that as a result of the flood many long delayed improvement projects had been forcibly brought to public attention and this will react favorably in fostering their accomplishment. In this connection he referred to interstate legislation favoring flood-control work on the upper reaches of streams and stated that storage reservoirs for impounding flood waters will also serve a highly useful purpose in providing additional water for stream dilution purposes during low summer flows when proper sanitary conditions are difficult to maintain.

Stating that in times of disaster no community should find it necessary to be without adequate protection of its water supply, W. S. Hutton, of the Wallace & Tiernan Co., gave assurance that equipment manufacturers and chemical companies considered it part of their responsibility to be prepared to render aid in flood emergencies. Standing orders are issued to field personnel to report immediately to health authorities with offers of assistance in areas that have been stricken.

Also included in the symposium was a paper by F. H. Waring, chief engineer of the Ohio health department, concerning floodflow frequencies on the Ohio River and emergency measures in inundated areas, and an illustrated talk by Caleb Mills Saville, chief engineer of the board of water commissioners of the Hartford metropolitan district, on the Connecticut River flood.

Forecasting floods

Montrose W. Hayes and H. R. Byers, chief of the river flood division and meteorologist respectively, of the U. S. Weather Bureau, discussed meteorological aids in connection with hydrological forecasting. It was brought out that the technique of estimating floodflows had been improved in recent years through utilization of meteorological science. In the past it was customary to superimpose heavy rainstorm conditions on a drainage area above the reach for which an estimate was being made, and in that way formulate conclusions regarding probable flood conditions. Now the procedure is not only to consider conditions near the ground surface, as indicated by barometric changes but, in addition, to bring in the probable effects of upper air masses. Dr. Byers described the principles of air mass analyses, a system of investigation which takes into account the effect of physical factors on air movement. It was pointed out that air passing over oceans, ice caps and deserts acquires definite characteristics of temperature and moisture. Knowing the origin, path of direction and extent of these air masses, it is possible to interpret their resultant effect on rainfall and other weather variables.

The practical utilization of flood data was outlined by Robert E. Horton, consulting hydraulic engineer, who stated that the necessary basis for sound flood-control engineering was an understanding of surface run-off phenomena. The infiltration theory of surface run-off, as developed by the speaker, was offered as a rational method of integratng the processes involved in run-off, the factors controlling these processes, and the relation between them. This theory is based on the proposition that total sur-

face run-off in any storm equals the total rainfall minus total infiltration and includes among other things, observations on infiltration capacity, depression storage and surface detention.

Papers on filtration

In a paper on sand filter operation, John R. Baylis, physical chemist of the department of public works, Chicago, pointed out a number of ways for obtaining improved performance. He laid particular stress on crack formation, mud ball accumulations and jet action, the latter taking place in the gravel-sand interface when material not in motion is next to the sand layer which is in motion during the back-washing operation. This, he explained, can be overcome by careful gradation of gravel at the interface. Of the various methods of filter bed washing it was his opinion that the filter wash system was probably the most effective.

Reporting experiences with anthracite filter mediums, at two plants of the Philadelphia Suburban Water Co., H. S. R. McCurdy, chief engineer, stated that considerable savings in wash water were effected. The coal filters were operated in parallel with similar units filled with sand and in that way comparative results were obtained. It was noticed that the coal filters cause a slight reduction in the residual chlorine carried from the water going to the filters; the efficiencies were about the same, but the coal filters gave 78 and 87 hr. runs as compared to the 56 and 64 hr. runs obtained on the parallel sand filters.

British waterworks practice

The address by Harold J. F. Gourley of London enabled American engineers to obtain an intimate picture of the problems and recent developments in British waterworks practice. This comprehensive paper included discussions on the legislative and engineering aspects of underground water and water conservation, dam construction, and hydraulic research. In the latter field was described experimental work relating to the design of circular spillways with particular emphasis on studies referring to flow velocity, the effect of entrained air and methods of eliminating vortex action. Of three schemes tried for ending vortex action—radial fins, radial piers and a diametral wall or curtain installed in the mouth of the tube—the latter has proven to be the most effective.

An interesting piece of dam construction was described in which the face was constructed of articulated concrete blocks independent of the buttress core wall. The downstream embankment, composed of carefully fitted granite blocks, was separated from the core wall by a sand wedge. Thus, when the reservoir was filled the pressure on the core wall was transmitted to the granite embankment through the sand cushion. (*A description of this dam will be published in a later issue.*)

Groundwater regulation in England is inadequate and needs revision, according to Mr. Gourley. At present there are no restrictions on depth or amount of water that can be drawn from wells on private property and consequently new installations may be placed in operation without regard to existing wells. Water authorities or purveyors, however, cannot install wells without Parliamentary consent, and if the privilege is granted, they are liable to damages within a two-mile radius where the water table is affected. Manufacturers and industrial users on the other hand, are not required to obtain a license for well construction. It was stated that as a result of this confusing situation many serious conditions have developed and measures are being sought to provide uniform license regulations.

High evaporation losses

In a formal discussion of Mr. Gourley's paper, Malcolm Pirnie, consulting engineer, reported on the extensive study of groundwater conditions in Florida, from which it was determined that in this locality a rainfall of less than 0.3 in. contributed nothing to run-off and groundwater replenishment, but was entirely lost through evaporation. On the assumption that a precipitation of at least 0.6 in. is required in a single rain, more than one-half of the rain during the drought season was therefore unproductive as a source of water supply. Further discussion by Karl L. Kennison, assistant chief engineer of the Boston metropolitan water district, pointed out some advantages of regional schemes for water development and supply.

New York City water supply

The development of the water supply for the city of New York, and the present plans for securing additional water to meet growing needs were discussed in two papers presented by Joseph Goodman and Walter E. Spear, chief engineers respectively, of the department of water supply, gas and electricity and the board of water supply. Mr. Goodman, in tracing the successive steps of developments pointed out that the first water supply in New York was a public well opened in 1677 at the southerly tip of Manhattan Island. It was not until a century later that a small reservoir with a distribution system of wood pipes was constructed in downtown New York. From these humble efforts has been developed a vast system of reservoirs, dams and piping which now makes possible the distribution of more than 1,000,000,000 gal. of water a day.

The distribution system for New York at the end of 1935 included more than 4,624 miles of cast iron and steel pipe varying in diameter from 4 to 72 in.; steel pipe with protective linings is now being used in all services 30 in. and over. In a piping system of this extent leakage is an important factor. A regular field force is constantly employed to seek out leaks and an average of 14 m.g.d. per year's loss is thus eliminated; when leakage survey work was intensified in 193[illegible] by the addition of special field parties an additional 26 m.g.d. per day loss was stopped. The cost of underground waste elimination is about $3 per million gallons, considerably less than what it costs to produce an equivalent amount.

The legal litigation and financial obstacles that have beset New York since 1921 in the development of additional supplies in the upper branches of the Delaware River were outlined by Walter E. Spear, who stated that curtailment of consumption during the depression and abundant rainfalls since 1931 have concealed the seriousness of the present inadequate supply. Funds have now been provided for starting work on the Delaware project which comprises construction of reservoirs on tributaries of the Delaware River and Upper Rondout Creek, and an 85-mile tunnel aqueduct. It is expected that initial contracts will be ready for bids late this year. The entire project will require seven to ten years for completion and is estimated to cost $210,000,000.

Well supplies at Dayton

The development of the groundwater supply for Dayton, Ohio was described by W. W. Morehouse, director of the water department. He stated that at present the city is drawing all its water from 132 wells driven into the huge underground basin which was formed in the Ice Age when glacial till was deposited in the old limestone channels of the Mad River. These wells vary in size from 8 to 38 in. in diameter, the latter size producing from 2 to 7½ m.g.d.

Silver water sterilization

Sterilization of swimming pool water by means of ionic silver dispersion (Katadyn process) is not approved for use in New York City municipal pools, according to a paper presented by Frank E. Hale and Robert Shapiro, director and bacteriologist respectively of the laboratories of the department of water supply, gas and electricity.

Extensive experiments were carried on in two pools equipped with electrical apparatus for introducing colloidal silver. The results of this investigation led to the following conclusions: (1) While organisms of the B. coli group were eliminated, the 37-deg. plate count indicated at times the presence of pathogenic bacteria known to be responsible for eye, ear and throat infections; (2) the sterilizing action required a two-hour period of contact which is too low for use in pools; (3) the turbidity of Catskill waters was increased with the addition of silver, and in salt water the silver action was lessened; (4) the process was more costly to apply than other methods and there

was a possibility that the colloidal silver would cause a permanent skin discoloration known as *argyrosis*.

A superintendents' session and round-table discussion on a wide variety of operating problems constituted the concluding feature on the technical program of the convention.

The new officers elected for the coming year were as follows: President, Harry U. Fuller; vice-presidents, Warren J. Scott and George A. Sampson; directors, Percy A. Shaw, Harold K. Barrows and Francis Kingsbury; treasurer, Leland G. Carlton; secretary, Frank J. Gifford; editor of journal, Gordon M. Fair; executive committee, Howard M. King and Roger Estey.

Letters to the Editor

Chemical Solidification on the Moscow Subway

Sir—Comment by Mr. H. T. B. Harding of London, England (*Engineering News-Record*, July 16, 1936, p. 94), on chemical solidification as developed (?) by the Russian committee speaks with commendable frankness. Because I am working with a similar chemical process in the United States I read Mr. Harding's comment with interest and I concur in his conclusions.

Two points in Mr. Gutman's article (*Engineering News-Record*, April 9, 1936, p. 515) are noteworthy: (1) The unit cost of solidified material is given as "only a small fraction of the German firm's estimate" ($18 per cu.yd.) and (2) the crushing strength of the chemically solidified material when 15 to 20 min. old is given as 280 to 850 lb. per sq.in "or even 3,600 lb. per sq.in. when the quicksand abounds in quartz."

On a large solidification job such as the Moscow subway tunnels the cost under conditions obtaining in the United States should run about $12 per cu.yd. The crushing strength of chemically solidified material depends upon the grading and the granular quality of the aggregate. Therefore, since neither the grading nor the quality can be controlled, as in the case of concrete, strengths comparable to that of concrete cannot be expected. The strength under compression of well-graded material rich in quartz that has been solidified by the chemical method should run about 800 lb. per sq.in. when 7 days old.

The Russian engineers probably cannot improve the chemistry of the process to any considerable extent if at all. Hence, if they have produced a cheaper and better product than anyone else it must be by means of a better mechanical application of the chemicals.

I was sufficiently interested in this point, after reading Mr. Gutmann's article, to have my son go to Moscow to investigate. There he was given every aid in seeing the job and details were explained in a most thorough manner by the Russian engineers in charge. He reports that the chemicals are pretreated and that certain labor-saving devices for injecting them have been developed. The costs are hard to interpret and certainly are not comparable to costs for work done in this country.

I have received two test cylinders taken from the chemically solidified material on the Moscow tunnel job. Their appearance indicates they are very good, but I do not intend to crush them immediately—they may not have had time yet to reach the 3,600-lb. per sq.in. stage!

LARS JORGENSEN
Consulting Engineer

Berkeley, Calif.,
Aug. 27, 1936.

Correction

Sir—Two typographical errors occur in my article on the "Numerical Value of Web Splices" (*ENR*, Aug. 20, 1936, p. 273). In the second paragraph, line 9, the expression should be $(R/d)\Sigma x^2$ instead of $(R/D)\Sigma x^2$. Also near the end of the article in the formula for I_s, the figure in the denominator should be 18,000 instead of 1,800.

FREDERICK L. HOUGH

Brooklyn, N. Y.
Sept. 2, 1936.

Bituminous Concrete for Galveston Jetties

Sir—There are several slight errors in the article titled "Rubble Jetties Made Solid With Asphaltic Concrete" in *Engineering News-Record*, Aug. 20, 1936, pp. 263-265.

Fig. 2 on page 264 should be titled "Typical Section of Rubble Jetty." It is not the original section of the Galveston jetty but is a much later development. Construction of the Galveston jetties was begun more than 50 years ago and at that time fascines rather than stone mats were laid down for jetty bases.

Referring to line 25 on page 264, 2 should read 5. Referring to the third line from the bottom of the first column on page 265, 300 should read 3,000. It is considered that successful placement of hot mix into unconfined seawater presupposes the use of units of mass large enough to retain a fairly large volume of internal heat. For the experiment referred to on page 265, the units of 3,000 lb. were accepted only because the experiment was considered to be in the laboratory stage. For actual deep water placement, it is considered that units of hot mix should be not less than 2 tons in weight.

It is suggested that these corrections should be published to correct any misapprehension by readers especially with respect to the units of mass for underwater placement where small masses are useless.

F. B. WILBY
Colonel, Corps of Engineers
Division Engineer

New Orleans, La.
Aug. 26, 1936.

Correction

Sir: The article on page 307 of the August 27th issue entitled "Land Title Discrepancies Present Surveying Difficulties" contains the following errors:

The description of the first parcel is described as beginning at a point 1320 ft. west of the south west corner of Lot 2. This should read 1320 ft. west of the southeast corner of Lot 2.

The description of the second parcel is given as beginning at a point south of the north corner of Lot 2. This should read, south of the northeast corner of Lot 2.

An obvious error in the next paragraph gives 20.4 rods as equal to 1346.7 ft. This should be 20.4 chains.

HERNDON P. CALONEY

Lakeland, Florida.
Sept. 7, 1936.

The Wichert Truss

Sir—In connection with the article "Continuity and Determinacy Combined in New Bridge," which appeared in *Engineering News-Record*, Sept. 3, 1936, p. 328, it may be of interest to engineers to know that the Wichert Truss was patented by Ernest M. Wichert under U. S. patent No. 1,842,136 on Jan. 19, 1932, and reissue No. 18,973 on Oct. 24, 1933.

The writer in cooperation with several other engineers had occasion to make some studies of this type of structure in the spring of 1933 and it was then traced back as far as the 1887 edition of "Graphische Statik der Baukonstruktionen," by Muller-Breslau. The edition available at the present time is the fifth (1912), where the subject is presented in the 13th chapter, beginning with p. 515.

Is not the term "rhomboid constant" a misnomer? The polygon does not appear to be more than a quadrilateral.

It is rather surprising that this type of structure has not been used before, when one considers its many important and obvious advantages.

HALVARD W. BIRKELAND,
Bureau of Reclamation

Denver, Colorado
September 23, 1936.

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October 1, 1936

To Be Read

A SERIES OF ARTICLES on current highway problems is begun in this issue and will be continued throughout most of the year. As we approach the third decade of the era of modern roadbuilding inaugurated by the federal-aid law of 1916, large problems of administration, road service and road operation call for solution. The information available for solution is astonishingly meager and opinion on the procedure to be followed is widely at variance. Surveys now in progress under federal and state direction will put knowledge of road service and road needs far ahead of that had in the past, but until the vision of engineers has projected this factual knowledge into creative planning the possibilities of road transport will not be served. It is the purpose of the series of articles begun this week to present a reflection of this visioning thought. Writers will speak whose experience in roadbuilding and road transport is spiced by bold thinking and fearless expression of opinion. Engineers will find in what is written much to beget thought and probably much in detail to dispute, but always also an inspiring example of constructive minds at work.

Wanted: More Beavers

BEAVERS WERE THE FIRST "UPSTREAM ENGINEERS," said Earle H. Clapp, acting chief of the U. S. Forest Service, at the Upstream Engineering Conference last week, and they "built dams such as college-trained engineers in the CCC are now trying to build." Mr. Clapp's remark may appeal to those who see the conservation of our water and land resources as beginning with the holding back of "little waters," for the key to such operations lies in keeping down the cost of the construction and maintenance of the small dams, and it has been found that the cost and maintenance of the individual check dam is out of all proportion to the direct benefit that it brings. Mr. Clapp, referring to the fact that the beaver is indigenous to a large part of the country, suggested that the industry of trapping beaver could be revived by restocking the headwaters of many streams. If we grant that the construction of many small ponds at the headwaters of our rivers is really desirable, restocking of forest areas may be the answer to the cost problem, and in time beavers may replace the CCC boys as dam builders.

Pipe Network Analysis

FOR THE FIRST TIME a workable method of analyzing pipe networks becomes available to the waterworks engineer, through the ingenious adaptation of trial-and-error procedure by Prof. Hardy Cross; it is explained on another page by Prof. Doland. The method is not hard to master if care is taken to learn its principle thoroughly and to arrange the calculation on the model of the neatly systematized form outlined in the diagrams that accompany the explanation. In new layouts better water service and saving of pipe costs can be obtained through use of the method; in existing networks the effect of tanks and feeder mains to relieve local low-head conditions can be studied with a precision not heretofore attainable. The development of the method makes a real contribution to the water art, the more notable because coming from a structural engineer. In due course, perhaps, the water art may return the service by a corresponding contribution to structural practice.

Bargain Prices on Engineers

NO MORE STUPID DEMONSTRATION of the fallacy of cut-price buying has come to attention than that in a small town of a nearby state. For many years the municipal engineering work of this community had been handled by an elected engineer who was paid a stipulated per diem fee—modest but apparently satisfactory to all concerned. The advent of a new administration this year, however, put a new value on the services of the city engineer when it was decided to have the engineering work paid for at the rate of $17 a week. The town officials, adamant in their belief that professional services are worth no more than the hire of common labor, employed recent college graduates at this rate; the engineer himself declined to serve on the same basis. It is not difficult to imagine what has happened to the functioning of municipal engineering in this town; suffice it to say that the qualified engineer has been frequently called upon for consultation and advice, for which he makes a charge equivalent to the original stipend. The town's apparent bargain purchase of engineering services is an illusion, for not only are extra sums being paid for consulting advice but inadequate service is being obtained and the value of continuity is largely lost.

A Lake in the Desert

WHAT IS THE EFFECT of creating a large lake in the middle of an arid desert: Will it affect the climate? Lake Mead, the great reservoir impounded by Boulder Dam, should furnish an answer. Heretofore the only water in that region has been the narrow ribbon of the river deep down in the canyon of the Colorado, but completion of the dam is causing the slow flooding of a large area. Where before only hot rocks and heat waves existed, there now is a great depth of cool water. Incidentally this water will weigh something like forty billion tons, a load that may be enough to dent the crust of the earth, for which reason the U. S. Coast & Geodetic Survey is making accurate observations on benchmarks to compare before-and-after elevations of the adjoining terrain. Climatic effects ought to be equally worth watching. Under the desert sun evaporation is rapid (some 6 or 7 ft. per year), which adds a substantial volume of moisture to the extremely dry air and therefore must have some effect on cloudiness and rainfall. The question is whether this effect will be large enough to be noticeable. One observation has already been made: As soon as the lake began to form, air transport pilots who operate regularly over the route found that a mass of cool air seemed to rise and spread like an open umbrella over the lake area, and they now report further that their engines run at lower temperature over Lake Mead than before and after crossing. Such indications suggest that more extensive atmospheric and climatic changes may develop. Careful long-time observations should tell.

Construction Unionism

CONSTRUCTION is certain to feel the effects of the fight now raging between craft and industrial unionism in the ranks of organized labor. Just what these effects will be and how much the present construction labor situation will be disturbed are questions impossible to answer at this time.

Craft unionism in building has not proved a success. It has not been satisfactory to either labor or management, nor has it benefited the public. For labor it has provided organized protection to a small minority of construction workers, chiefly those in building trades. True, it has carried the hourly wage-rates of certain crafts to high levels—so high, in fact, that building work is often postponed or curtailed and new materials and methods have been forced into use to circumvent the high wages, all to the ultimate detriment of the worker himself. Against this dubious benefit, the craft system has fostered petty and even major racketeering in local unions; it has created a horde of so-called labor leaders who prey on the men they are supposed to help as well as on the construction buyer.

Construction progress has been stifled by the restrictions imposed by craft unionism. An example is the difficulty encountered in the development of prefabricated and factory-built houses—one of the logical means to bring home construction within the financial reach of millions of potential buyers—which has been held up by short-sighted resistance of organized building labor. The introduction of every new building material or process means a fight with labor. However, craft unionism's greatest failure lies in its inability to prevent the vicious jurisdictional dispute, by which labor, contractor and owner alike suffer.

For the employer, the present organization of construction labor offers no really responsible element with which to deal. A contractor or an association may sign agreements with certain trades, but such agreements give no assurance that other unions will not try to edge in and cause trouble—example, the recent New York subway case, where electrical workers struck to insist that they be given the work assigned to and agreed to by signal installers. Worst of all, the craft system gives management no control over labor. The employer cannot select his own men, he often finds the worker's production limited, and firing for incompetence usually leads to trouble.

Whether industrial unionism would eliminate all of the evils of craft organization is uncertain. Without doubt some of them would be curbed. The jurisdictional dispute should disappear. The extortion of the walking delegate would be largely ended. The employer could, when necessary, shift his men from task to task. As the plan works in coal mining, a workman may be switched at will from one job to another of equal pay rating; to a higher-pay operation by paying the scale of the new job; and to a lower-pay job with the worker's consent, or by maintaining his former pay level. For labor, industrial unionism would offer a chance for the rank and file of construction workers to come into the protection of organized labor, and might possibly provide that much-needed intelligent leadership now lacking in construction labor circles.

Perhaps industrial unionism is not the answer to the building labor question, but contemplation of its possibilities is interesting. The coming year may see the answers to present speculations as to the future course of labor organization in building. Whatever the answer may be, the interests of the industry, the client, the contractor and the worker alike require a thoroughgoing change in the present system.

Soil and Water Problems

UPSTREAM ENGINEERING problems differ little from those of midstream or downstream engineering in so far as water and soil conservation are concerned. That is the most definite conclusion to be drawn from the deliberations of the President's conference on Upstream Engineering held in Washington last week. Fundamentally, if confusion and conflict are to be avoided, a drainage basin must be considered as a whole.

The essential unity of a drainage area was emphasized by many of the speakers at the conference, and few of the speakers limited the scope of their papers to the upstream area. Only in such matters as flood-control on major rivers can a distinction be made in treatment between the upstream and downstream areas, and even then the river must be treated as a unit in determining the character and extent of flood protection works.

The purpose of the conference, as stated in the call, was to consolidate engineering information on soils, rainfall and runoff as they relate to flood-control and to soil and water conservation. Much valuable information on these questions will be found scattered through the numerous papers that were presented. But the assembly and consolidation of information affecting soil and water conservation does not stand out as an accomplishment of the conference; rather, the conference served to emphasize the need for additional data on rainfall and runoff and for research to evaluate the data.

Also brought out was the important fact—important chiefly as bearing on a present widely accepted misconception of the place of farm ponds and like small reservoirs in flood control—that small ponds on headwater streams cannot control major floods even if built in large numbers. Construction of such ponds, building of check dams in gullies, terracing and contour plowing may delay runoff, to some extent may increase infiltration into the soil, and may aid in reducing soil losses and silting, but are of little importance in checking major floods.

From another side the conference served a very useful purpose: It brought out repeated comment on the lack of sound engineering in the layout and design of the water conservation structures now being built by the government with relief labor. Check dams are being poorly built or are improperly designed for their purpose; many small dams already have failed structurally, and more have failed hydrologically, that is, have failed to store water when water was needed. It is significant that some of this frankly expressed criticism came from men known to be in sympathy with the Administration's plans for coordinated development of land and water resources.

Thus the conference, despite its evident lack of coordination, was not without value. If it fell short of what its promoters had hoped to accomplish in the way of consolidating engineering information, that was due chiefly to the impossibility of the task set. A more immediately useful purpose will have been served if the conference does impress federal services with the need for fuller hydrologic data and better engineering in connection with their soil and water conservation activities.

CURRENT NEWS

Price Set for Aqueduct Water

The board of directors of the Metropolitan Water District of Southern California has stated that a rate of $15 per acre-ft. will be charged for Colorado River aqueduct water delivered to cities and areas within the district. At the same time the board stated that Colorado River aqueduct water will be made available only to cities within the district.

The announcement stated that "a wholesale rate of $15 per acre-ft. amounts to a rate of 3.45 cents per 100 cu.ft. For all domestic, commercial, and industrial water now retailed to consumers within the thirteen district cities an average rate of 12 cents per 100 cu.ft. is now paid.

"Construction work on the aqueduct is now almost half completed. It is expected that aqueduct water will be available for delivery by 1939. An ordinance fixing a wholesale water rate to be charged by the district will be adopted prior to the delivery of aqueduct water, and the board at this time is expressing its best judgment on this subject in the light of conditions now apparent."

The board issued its statement in response to a number of inquiries from Southern California cities and areas considering the possibility of securing Colorado River aqueduct water.

Concrete construction work on the desert sections of the aqueduct is scheduled to be resumed Oct. 1. During the summer period of intense heat on the desert, the work of placing concrete in the canal and conduit sections of the aqueduct was discontinued pending cooler weather. It is estimated that more than 1,000 additional men will go to work on the aqueduct when work on the desert sections is resumed. About 10,000 men will be employed on the aqueduct this year.

Dam Failure in Nebraska

A 150-ft. concrete section of the earth and concrete dam of the Northern Nebraska Power Co., 7 miles south of Spencer, Nebr., on the Niobrara River, failed on Sept. 24. The entire dam is 1,800 ft. long. The concrete section was 18 ft. high.

F.A.E.C.T. Joins A.F. of L.

The Federation of Architects, Engineers, Chemists and Technicians on Sept. 19 affiliated itself with the American Federation of Labor by merging with the International Federation of Technical Engineers, an A.F. of L. affiliate. According to the terms of the agreement, all F.A.E.C.T. chapters will be accepted and granted charters as locals of the A.F. of L. International Federation on application.

Further Floods in Texas

Brazos River and tributaries at record heights with lower Brazos still rising —Colorado floods subside

NEW FLOODS struck in Texas on Sept. 27 and 28, as the Brazos River and its tributaries, the Leon, Little and Lampasas Rivers, reached record heights. Meanwhile, last week's floods on the Concho and Upper Colorado Rivers had flattened out by the time they reached the Lower Colorado; little damage was done in Austin or towns to the south along the Colorado.

Brazos Valley

Damage in the Brazos valley centered at Waco, ninety miles south of Dallas. At that city the Brazos River reached the highest level on record, flooding the entire eastern section of the town. A levee a mile above Waco was washed out. Damage estimated at $2,000,000 occurred in the city, and 2,500 people were homeless. It is believed that no lives were lost. A gas line serving twenty-five communities south of Waco, was washed out at Waco; the communities affected are using an emergency auxiliary system until the line is repaired. At Milford, north of Waco, a new steel bridge over Will Creek was washed out, and at Italy, Texas, nearby, a freight train of the I.G.&N. Ry. went through a bridge where the tracks had been washed out. A highway bridge at Hamilton, west of Waco, was washed out.

Meanwhile, to the south, the Little River, fed by the flooded Leon and Lampasas Rivers, was pouring a new flood toward the Brazos. Great fear was expressed for the safety of the lower Brazos valley.

Colorado River

Fears of extensive damage in the Lower Colorado River when last week's floods in the Concho and Upper Colorado came downstream, proved unfounded. The flood crest had flattened out by the time it reached Austin, although a few of the lower sections of the town were flooded. A section of the Llano branch of the P.&N.O. Ry. was washed out at Austin. At Marble Falls, north of Austin, the city power plant was crippled by the rising waters and a railroad bridge was washed out.

Brazos Control Project

Work will start this fall on a $36,000,000 flood control project in the Brazos valley which, in the opinion of John A. Norris, general manager of the Brazos River Conservation and Reclamation District, would have prevented this flood. If dams on the Leon and Lampasas, which join to form the Little, and one of the major dams upstream on the Brazos has been built, he declared, this disaster could have been averted.

Baton Rouge Bridge Approved by War Department

The War Department has approved the plans of the Louisiana state highway commission for a fixed bridge across the Mississippi River at Baton Rouge.

The proposed bridge would be erected and financed by the Louisiana highway commission. It will have a single railroad track in the center with a 2[illegible]-ft. roadway on each side. Trains will use the railroad crossing on a toll basis, but the bridge will be free to vehicle traffic.

Plans for the bridge call for a three-span structure over the navigable portion of the stream. The center span will be 620 ft. long and the side spans 820 ft. Vertical clearance will be 65 ft. above the 1927 maximum river level, or 112 ft. above mean low water. The bridge will cost about $7,000,000, of which $5,500,000 will come from state highway bonds and $1,500,000 from federal aid funds.

The present project displaces plans for a structure financed jointly by the railroads and the highway commission.

Generators Started At Seattle's Diablo Dam

The first unit of Seattle's Diablo power development went into action on Sept. 23 when President Roosevelt pressed the button that started a 95,000 hp. generator.

Power from this unit will eliminate the necessity of operating the Lake Union steam plant and of buying power from the Tacoma municipal system. Within another few months the second unit of the Diablo plant will start functioning, adding another 95,000 hp.

Work is expected to start soon on construction of Ruby Dam, 6½ miles above Diablo Dam. This will be a concrete dam 100 ft. high, which will impound 130,000 acre-ft. of water.

The PWA has just made a grant of $3,000,000 for constructing of Ruby Dam and of a power transmission line to connect the Skagit River generating plant with the city of Seattle. The remainder of the cost of the $8,000,000 project will be financed from city bonds.

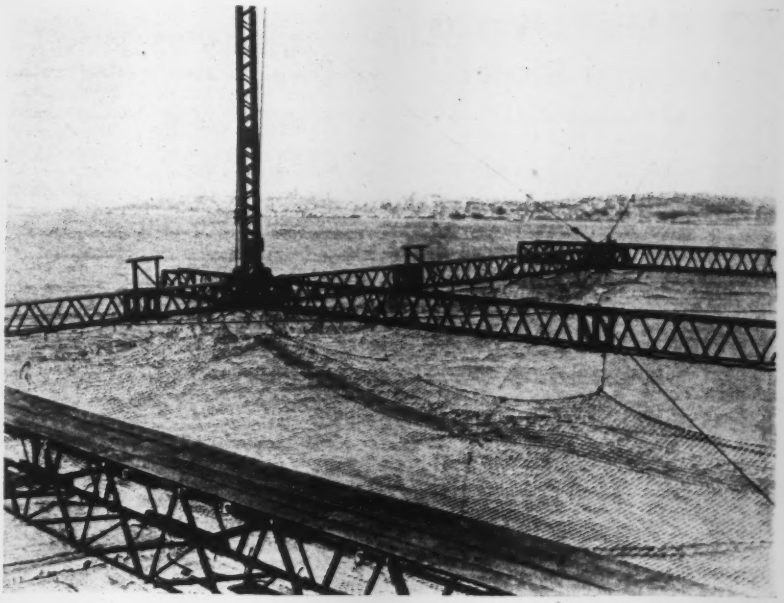
The cost of the Ruby dam and reservoir is estimated at $4,685,000 and of the transmission system at $2,354,000. The transmission system is designed to carry power from the just-opened unit at Diablo Dam, from the second Diablo unit, of equal capacity, which will go into production within several months, and from the Ruby Dam. The present Skagit transmission line has only sufficient unused capacity to carry the power produced by the first unit.

Some time in the future, it is planned to raise Ruby Dam to a height of 635 ft., providing complete control of the Skagit River.

A.G.C. Officials Plan Tour

President W. A. Klinger and managing director E. J. Harding, of the Associated General Contractors of America, plan to start Oct. 7 on a tour through the western states to confer with local chapters of the association and with prominent contractors on the problems facing the contracting industry. The tour is planned in connection with the fall meeting of the governing and advisory board of the A.G.C., which will be held at Washington, D. C., on Nov. 16-17.

Problems to be discussed include the revival of private construction, the continuation of federally financed public works construction, and day labor activities of the government in the construction field. The A.G.C. officials hope to talk with more than 500 of the leading general contractors in the western part of the United States.



AS WORK PROCEEDS on the suspended structure of the golden gate bridge, workmen are protected by a safety net slung below. The net is in two parts; the permanent section can be seen hung below the completed trusses in the lower picture. A movable net is kept in front of the advancing span; a close-up of this section is shown above.

Hydrologic Studies Recommended

Water Resources Committee recommends a federal program for study of hydrologic data

A REPORT submitted to the National Resources Committee by a subcommittee of the Water Resources Committee recommends that the federal government undertake a comprehensive program for the collection of hydrologic data. The committee points out that the direct cost to the nation of insufficient information on hydrologic facts has run into millions during the past half century. Thus, the report states, during the past 50 years 60 important dams have failed; a considerable portion of these failures have been due to inadequate spillway capacity, a fault which is directly traceable to lack of adequate knowledge of stream flow to be expected.

The committee further points out that many indirect losses are derived from lack of adequate information. Large investments are affected in such matters as "urban real estate exposed to floods; cities relying on a plentiful supply of unpolluted waters; improved farm lands whose value may be lost by flooding; and industries which cannot plot their future without some means of knowing what water conditions are to be."

A comprehensive program to remedy the current lack of information is suggested by the committee. According to the plan, the federal government would establish a basic network of stations to measure precipitation, snowfall, streamflow, groundwater levels, evaporation, and water quality. The federal government would share the cost of adding supplementary systems to this network, wherever local non-federal agencies were willing to provide part of the money.

The committee estimates that such a network of stations could be established for an initial expenditure of $3,676,500; the federal government would provide $2,906,250 of this, and local agencies $770,250. After the first year, it is estimated, maintenance of the stations would require about $1,824,000 annually, of which the share of the federal government would be $1,429,500.

The recommendations were prepared by a committee representing engineers from all important regions in the country and have the endorsement of the chief federal agencies using hydrologic data.

The need for such data was stressed at the Upstream Engineering Conference, as noted elsewhere in this issue.

Quabbin Contracts Declared Illegal

Massachusetts attorney-general declares contracts awarded to high bidder are null and void

ATTORNEY General Dever, of Massachusetts, in a report to the governor, declared that contracts recently awarded by a majority vote of the Boston Metropolitan District Water Supply Commission to Two Companies, Inc. and Cendella & Co. for work in connection with the $65,000,000 Quabbin reservoir project, are, in his opinion, void. The contract in question was not awarded to the low bidder, the Benjamin Foster Co. having offered a bid $278,000 less than that on which the contract was awarded.

The report of the attorney-general stated that these contracts are not binding and constitute "an unwarranted and unnecessary expenditure of public funds of over $400,000 in excess of the amount for which such work could be done, even assuming that it was desirable to have the work done."

The contract to the Two Companies, Inc. would have given to that concern extra work amounting to $397,000. The Benjamin Foster Co. had agreed to do the work for $119,000. Commission engineers had stated that the work involved was unnecessary at this time.

The attorney-general stated that "the evidence showed that since its inception more than $1,000,000 worth of work has been given out by this commission as extras or by fastening on existing contracts new projects that could not be fairly considered as part or parcel of any existing contract and without any competitive bidding." The attorney-general recommended that "legislation should be enacted requiring the commission to advertise publicly for bids and to award final written contract in every case where an expenditure of over $1,000 is made, and until this legislation is secured the commission should adopt such a measure by an appropriate rule or a regulation."

The matter has created a grave situation in the state with respect to the future conduct of the commission's affairs.

Engineering Night Schools In Buffalo and Chicago

Graduate engineering work on a night school basis has been made available to students in the Chicago area, for the first time, by an arrangement worked out by the educational committee of the Western Society of Engineers. Arrangements have been made for graduate courses in engineering subjects to be offered in the evenings and on Saturdays at several technical schools in the city: the Armour Institute of Technology, Lewis Institute, the University of Chicago, and the University of Illinois. Courses offered in civil engineering include a course on continuous frames by Prof. Hardy Cross at the University of Illinois, and courses in civil engineering by Prof. H. Ensz at the Armour Institute of Technology.

In Buffalo, a plan has been inaugurated whereby courses in civil and other branches of engineering are made available at the University of Buffalo, N. Y. The courses are designed for students already employed in engineering firms who desire to improve their training. The curriculum includes four years of part-time study in the evening sessions. A certificate is granted by the college if the candidate has engaged in acceptable engineering work for at least one year. Administration of the curriculum is in the hands of a committee composed of a number of professional engineers in the city and members of the faculty of the University.

Plans for World's Fair Described by Grover Whalen

One hundred million dollars will be spent to make the 1939 New York World's Fair the greatest international exposition in history, Grover A. Whalen, president of the World's Fair Corp., told a meeting of the New York Building Congress on Sept. 30. This sum will be spent not only by the fair corporation, he said, but also by the city and state for providing basic improvements to the fair site, and by exhibitors and concessionaires. Estimates of costs and anticipated revenues show that there will be a profit from the enterprise which will be turned over to the city for restoration of the site as a permanent park, the speaker declared.

Buildings will be erected on the 1,130-acre site—now being graded—which will have more than 2,500,000 sq.ft. of floor space to house exhibits of governments, institutions, business houses, restaurants, stores and amusements. "Like a city," Mr. Whalen said, "a fair means much more than buildings. It requires such improvements as parks and streets, bridges, storm and sanitary sewers, water and electric utilities. It involves the development of services which every city provides for its citizens—police, fire, health, sanitation and inspection. It requires building codes and zoning ordinances. In addition, the New York Fair will have an intramural transportation system the like of which no other fair has ever seen."

"We have gone to great pains and we have drafted the finest talent to make the fair unique, incomparable, inspiring. The fair authorities resolved to build a world's fair conceived on new lines, or none at all. The fair will present the most substantial and the most brilliant achievements of modern art, science and industry. It will show not merely manufactures and merchandise, but the social consequences of these new processes and arts."

In speaking of planning and construction, Mr. Whalen said, "We plan no centralization of building and architectural activity. We plan to 'farm' the work out to only the best architects and to the most competent construction firms, building contracts to be awarded on the basis of competitive bidding."

The site of the fair on Flushing Meadows in the borough of Queens is now being graded and filled in, and planned as a permanent park for the city. (A complete story of grading operations will appear in an early issue of *Engineering News-Record*—Editor.)

15 Alabama Bridges Freed of Tolls

Fifteen toll bridges in Alabama owned by the Alabama Bridge Corp. were made free bridges on Sept. 29. The change was accompanied by ceremonies throughout the state.

The state is not buying the bridges; the state highway department is renting them from the Bridge Corp. for $275,000 per year. Freeing the bridges was dependent upon agreement of the bondholders to a plan for refinancing the 5 per cent bridge bonds of the Alabama Bridge Corp., which have been in default on a 4 per cent basis. The annual rental from the state will now be sufficient to carry interest and amortization taxes on the refunded bonds.

The bridges were built in 1929 and 1930 when the bridge company was organized as a semi-public corporation.

The Cochrane bridge over Mobile Bay is not included in the bridges being freed.

SOCIETY CALENDAR

CANADIAN INSTITUTE ON SEWAGE AND SANITATION, Royal York Hotel, Toronto, Oct. 1-2, 1936.

INTERNATIONAL CONGRESS ON THE BUILDING OF STRUCTURES ABOVE GROUND, Berlin, Germany, Oct. 1-8.

INTERNATIONAL CONFERENCE ON STEEL CONSTRUCTION, Berlin, Germany, Oct. 2-7.

INTERNATIONAL ASSOCIATION FOR BRIDGE AND STRUCTURAL ENGINEERING, second congress, Berlin, Germany, Oct. 1-11.

NATIONAL SAFETY CONGRESS, annual meeting, Atlantic City, N. J., Oct. 5-9.

NATIONAL ROAD OIL AND ASPHALT CONGRESS, annual session, Tulsa, Okla., Oct. 8-9.

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS, annual convention, Washington, D. C., Oct. 12-13.

AMERICAN SOCIETY OF CIVIL ENGINEERS, fall meeting, Pittsburgh, Pa., Oct. 13-17.

NATIONAL COUNCIL OF STATE BOARDS OF ENGINEERING EXAMINERS, annual meeting, Knoxville, Tenn., Oct. 19-21.

AMERICAN WELDING SOCIETY, annual meeting, Cleveland, Ohio, Oct. 19-23.

AMERICAN PUBLIC HEALTH ASSOCIATION, annual meeting, New Orleans, La., Oct. 20-23.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual convention, White Sulphur Springs, W. Va., Oct. 21-23.

HIGHWAY RESEARCH BOARD of the NATIONAL RESEARCH COUNCIL, annual meeting, Washington, D. C., Nov. 18-20.

STRUCTURAL ENGINEERS ASSOCIATION OF CALIFORNIA, annual convention, Santa Maria, Cal., October 16-18.

AMERICAN WATER WORKS ASSOCIATION, NEW JERSEY SECTION; NEW JERSEY WATER WORKS ASSOCIATION; and the SOUTH JERSEY ASSOCIATION OF WATER SUPERINTENDENTS; joint meeting, Atlantic City, N. J., Oct. 23-24.

CENTRAL STATES SEWAGE WORKS ASSOCIATION, annual meeting, Indianapolis, Ind., Oct. 29-30.

At a meeting of the AMERICAN SOCIETY OF CIVIL ENGINEERS, VIRGINIA CHAPTER, the following officers were elected: president, E. M. Hastings; vice-president, Francis J. Sette; secretary, R. Cooper Bailey; treasurer, W. W. Archer.

EXAMINATIONS for registration as Engineers, Land Surveyors and Architects will be held as follows:

NEW YORK STATE, examination for professional engineers and surveyors, Jan. 25-27, at Albany, Buffalo, New York City and Syracuse. Applications must be filed with the State Education Department at Albany before Nov. 1.

Arbitrating Union Jurisdiction

Washington Correspondence

THE MACHINERY by which John A. Lapp will act as national referee to deal with jurisdictional disputes between trades unions is being set up.

Under the new arrangement, when a jurisdictional dispute occurs a local settlement will be attempted. If the dispute cannot be settled locally, the building trades department of the American Federation of Labor may direct the presidents of the unions concerned to settle the matter within five days. If there is still failure to reach a settlement the building trades department may render a decision, but this decision is for the job only. Any union dissatisfied with the decision has a right to appeal it to the referee. No appeal may be made from any source other than from a union concerned. When the appeal has been duly made, the referee will hold a preliminary hearing to satisfy himself that the question has not been decided by any previous binding national decision. If it is not covered by a previous decision, he then calls a formal hearing at which interested unions may present their claims and counter claims. After briefs have been filed the referee will make his decision. Under the new arrangement work is to proceed during arbitration under the union then in charge of the work. All hearings will be held in Washington, probably at the Lee House.

Under this new arrangement the referee will be called upon to render decisions which involve millions of dollars. For instance, in determining whether the plasterers, bricklayers or the carpenters may have acoustical work, he will allocate to one or the other of the unions work that will mean many millions of dollars in wages over a period of years.

MEAD MEMORIAL AT BOULDER DAM

This memorial plaque, commemorating the work of the late Dr. Elwood Mead, commissioner of the Bureau of Reclamation from 1924 until his death in January, 1936, was unveiled at Lookout Point above Lake Mead, created by Boulder Dam, in the presence of delegates to the World Power Conference and the Congress on Large Dams, on Sept. 29. The site of the memorial is high on the wall of Black Canyon, a few hundred yards from Boulder Dam, overlooking Lake Mead.

Lake Mead is now almost 100 miles long and extends into the lower end of the gorge of the Grand Canyon.

Brief News

A CONTRACT HAS BEEN AWARDED for construction of the substructure and approaches to the First Narrows bridge at Vancouver, B. C., to Stuart Cameron & Co., Ltd. by the First Narrows Bridge Co. No figures were made public by the Bridge Co., but it is understood that the present contract will involve an expenditure of about $2,000,000. Contract for the steel superstructure is expected to be awarded before Dec. 1.

CONSTRUCTION OF A DAM 300 ft. high to store 25,500,000 acre-ft. of the water of the El Fuerte River, to irrigate 740,000 acres in the Topolobampo region on the Pacific Coast of Sinaloa State, is to be undertaken by the Mexican government in connection with arrangements that it is completing with the Kansas, Mexico and Orient Railroad to extend its lines from Ojinaga, Chihuahua State, to Topolobampo. It is expected that work on the dam will start early next year.

LINEAS FERRIAS DE MEXICO (Ferromex), the semi-official Mexican railway construction and operation company, has obtained a concession to build a railroad from Estacion Ixcaquixtla, Puebla State, to Chacahua Bay, on the Pacific Coast of Oaxaca State. The main line will be 223 miles long, and there will be three branches to important points in Puebla and Oaxaca. The line is to be laid on a 36 in. narrow gage, but the concession grants the right to increase the width to standard gage. The cost will be about $6,250,000. The railroad must be completed within twelve years from the date of the concession.

A NEW RECORD for rock placement on the San Gabriel dam No. 1, being built by the Los Angeles Flood Control District, was reached recently with the placement of 27,945 cu.yd. of rock in two 8-hour shifts. Since then the average progress has been raised to 26,000 cu.yd. per day; addition of a 3½ yd. shovel to the contractor's equipment is expected to increase this figure. The rock fill has now been carried up to a height of 80 ft. above stream bed, or 145 ft. above bedrock. This represents a total yardage in place on Sept. 19 of 4,039,124 cu.yd. Total yardage in the structure is to be 10,809,000 cubic yards. Rock for construction of the dam is obtained from a quarry in the canyon just below the structure.

THE NEW YORK CITY board of transportation has awarded the contract for construction of the section between 27th and 33d Sts. of the new Sixth Ave. subway to the Carleton Co. on a bid of $6,392,878. Work on this section includes the remodeling of the 33d St. terminal of the Hudson & Manhattan Railroad and special work in connection with avoidance of interference with the underground tubes of the B.-M.T. and the Pennsylvania Railroad. The board of transportation has advertised for new bids to be opened Oct. 2 for construction of the section between 33d and 40th Sts. The first set of bids on this section was rejected recently. (*ENR*, Sept. 10, 1936, p. 386.)

Personals

H. W. COLEMAN, who has been serving as project engineer for the Blue Ridge Parkway in Virginia, has been appointed city manager of Vinson, Va.

CAPT. EDWIN G. KINTER of the Civil Engineer Corps, United States Navy, stationed at the Norfolk Navy Yard, has been ordered transferred to the Bureau of Construction and Repair at Washington, D. C.

EDWIN C. FRANZEN, assistant engineer in the Rock Island U. S. Engineer District, has been transferred to the office of the Chief of Engineers at Washington, D. C.

A. J. HAWKINS, chief engineer for the WPA Administration in Alabama, and formerly city engineer for Birmingham, Ala., has been granted leave of absence to work with the engineering staff of the WPA in Washington.

HERMAN D. BAITY, director of the PWA for North Carolina, has resigned to accept an appointment as professor of sanitary engineering in the division of public health of the Medical School of the University of North Carolina.

HARRY MCGRAW, district engineer for northern West Virginia of the Virginia State Road Commission, has submitted his resignation in order to become a partner in the contracting firm of W. H. Armstrong of Washington, D. C.

S. S. STEINBERG, of the civil engineering department, has been appointed acting dean of the college of engineering of the University of Maryland. GEORGE C. ERNST, formerly an instructor in the department of mechanics at Iowa State College, has been appointed an instructor in civil engineering at the University of Maryland. HARRY R. HALL, chief engineer of the Washington Suburban Sanitary Commission, has been appointed lecturer on municipal sanitation.

Obituary

GEORGE A. HENDRIE, a civil engineer, died in New Rochelle, N. Y., on Sept. 23.

CLAUDE W. BROWN, 78, a Birmingham contractor and builder, died in that city on Sept. 24.

WILLIAM N. KENNEDY, a railway architect living at Winnipeg, Man., died Sept. 19, aged 63.

CLARENCE S. HOWELL, a consulting engineer specializing in foundation problems, died in Greenwich, Conn., on Sept. 24 at the age of 61.

FRANK D. FIELD, a consulting engineer, died in Lynbrook, N. Y., on Sept. 23 at the age of 71. Mr. Field had formerly acted as a consulting engineer in Boston.

JOHN C. WOLFE, a retired civil engineer formerly employed by the city of New York, died on Sept. 20 in Torrington, Conn., aged 63. He was a graduate of the Massachusetts Institute of Technology.

JOHN E. BROWN, president of the Thomas Brown Construction Co., Buffalo,

N. Y., died in that city on Sept. 21 at the age of 59. Mr. Brown had done many of the larger excavating jobs in Buffalo.

JOHN J. ROONEY, 51, county engineer of Sacramento County for the past three years, died in Sacramento on Sept. 14. For 12 years before becoming county engineer, Mr. Rooney had served as assistant engineer for the county.

LEO J. ROONEY, 72, an engineer of Tulsa, Okla., died in that city on Sept. 20. He had been engaged on engineering work on federal flood control projects in that state. In the past Mr. Rooney had been connected with the engineering departments of the Reading Railroad and the Shawmut Railroad.

ROBERT A. ROSS, a consulting electrical engineer of Montreal and a past president of the Engineering Institute of Canada, died in Montreal on Sept. 23 at the age of 72. Mr. Ross was a graduate of the University of Toronto; he had served as chief engineer to the Canadian General Electric Co. and to the Royal Electric Co. of Montreal. Since 1896 Mr. Ross had been engaged in consulting practice and has been responsible for the designs of many important electrical and power installations. At various times Mr. Ross served as consultant to the Hydroelectric Power Commission of Ontario, the Canadian Pacific Railway, and a great majority of the larger cities throughout the Dominion. He was president of the Engineering Institute of Canada in 1920, and in 1934 he received the Sir John Kennedy medal of that institute for outstanding merit in his profession.

CONSTRUCTION STATISTICS FOR THE WEEK

PUBLIC work takes the lead this week in producing a high volume of engineering construction awards, $57,070,000. This total is 27 per cent higher than the average week to date this year but below last week's record figure. Private work for the week is $19,384,000, 52 per cent ahead of the average week to date for this class but below the 6-year record volume established last week. Public work is $37,686,000, the highest since August 20. This sub-total is made up of federal, $6,260,000 and state and municipal, $31,426,000.

Corresponding values for a year ago are: total, $28,650,000; private, $9,444,000; public, $19,206,000; federal, $6,282,000; and state and municipal, $12,924,000.

Public buildings; earthwork, irrigation and waterways and unclassified types of construction register gains this week. The classified totals are: public buildings, $9,109,000; commercial buildings, $11,560,000; industrial buildings, $5,579,000; highways, $12,128,000; bridges, $1,240,000; sewerage, $1,179,000; waterworks, $230,000; earthwork, drainage, $5,232,000; unclassified, $10,813,000.

The larger projects for this week include: iron ore concentration plant, Manganiferous Mining Co., Trommaid, Minn., $2,000,000; brewery, Schlitz Brewing Co., Milwaukee, Wis., est. $600,000; 150 dwellings, Wilmot Woods, Haring & Blumenthal, New Rochelle, N. Y., $500,000; 6-story apartment for W. Schiff, Columbus, Ohio, $4,600,000; 4 buildings at Hollenbeck Junior High School, Los Angeles, Calif., $618,000; grain elevator, Kansas City, Kan., $858,000; additional buildings at Western District High School, Los Angeles, Calif., $522,000; clinical building for Medical Center, Jersey City, N. J., $763,000; sanitarium for Choctaw-Chickasaw Tribes, Talihina, Okla., for Dept. of Interior, $858,000; highways, by Missouri, $1,502,000; by Virginia, $554,000; by California, $663,000 and $516,000; by Florida, $1,143,000; by Ohio, $1,978,000; Conchas Dam on South Canadian River, New Mexico, $4,586,000; Route 101, Section 8, 6th Ave. Subway, New York, N. Y., $6,393,000.

New capital includes $10,016,000 in state and municipal bond sales which represents a large number of small issues in addition to a few large ones. PWA allotments add $4,557,000 and corporate security issues, $2,311,000.

CONTRACTS

(Thousands of Dollars)

	Weekly Average Oct. 1935	Prev. 4 Weeks	Week Oct. 1 1936
Federal Government	$6,563	$6,572	$6,260
State and Municipal	17,907	21,663	31,426
Total public	$24,470	$28,235	$37,686
Total private	12,056	21,108	19,384
Week's total	$36,526	$49,343	$57,070
Cumulative to date: 1935	$1,045,691,000	1936	$1,794,729,000

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

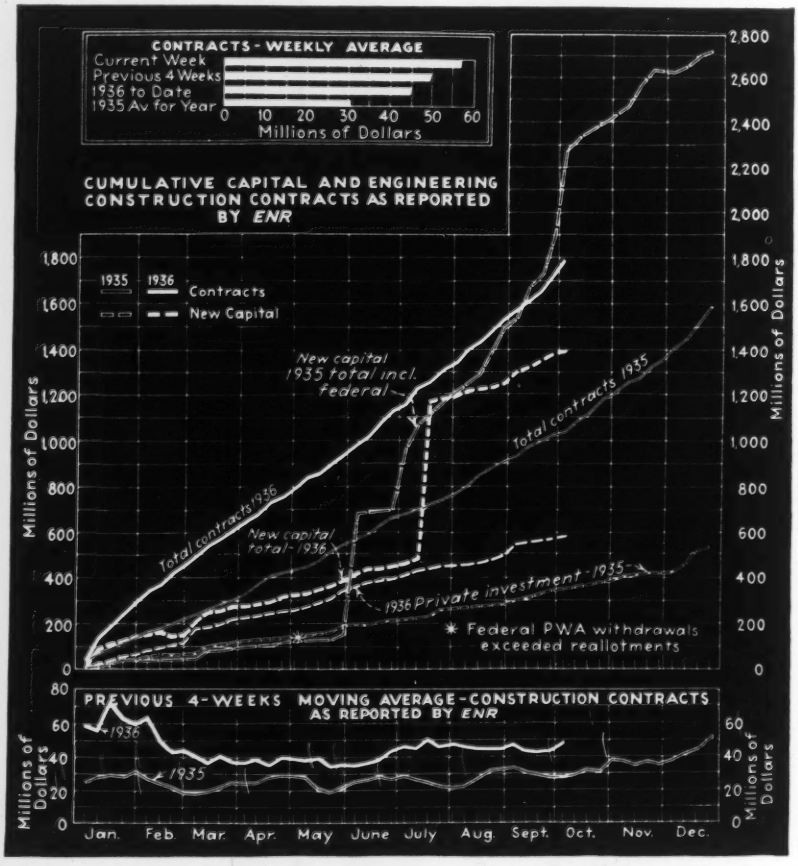
1936	Week Oct. 1	Cumulative
State and municipal	$10,016	$387,292
PWA non-federal	4,557	91,084
RFC loans		26,663
Corporate issues	2,311	203,909
PWA loans, Private		—1,665*
Total Non-Federal	$16,884	$707,283
Federal		691,237
Total new capital	$16,884	$1,398,520
Cumulative to date: 1935	$2,282,082,000	1936	$1,398,520,000

*Bond sales in this classification exceed reallotments during current year.

Note: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities. RFC direct purchase of bonds for "self liquidating" projects, and 25 per cent of WPA construction appropriations.

INDEX NUMBER

ENR	1913 = 100	1926 = 100	ENR	1913 = 100	1926 = 100
Cost Oct., 1936	211.50	101.67	Volume Sept., 1936	200	88
Sept., 1936	208.10	100.08	Aug., 1936	199	87
Oct., 1935	195.10	93.82	Sept., 1935	140	61
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47


CONTRACTS - WEEKLY AVERAGE
Current Week
Previous 4 Weeks
1936 to Date
1935 Av for Year
0 10 20 30 40 50 60
Millions of Dollars
CUMULATIVE CAPITAL AND ENGINEERING CONSTRUCTION CONTRACTS AS REPORTED BY ENR
1935 1936
Contracts
New Capital
New capital 1935 total incl. federal
Total contracts 1935
Total contracts 1936
New capital total - 1936
1936 Private investment - 1935
* Federal PWA withdrawals exceeded reallotments
Millions of Dollars
PREVIOUS 4-WEEKS MOVING AVERAGE - CONSTRUCTION CONTRACTS AS REPORTED BY ENR
1936
1935
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

Construction Equipment and Materials

Remote Control Unloader

The new model of the automatic remote control unloader, made by the Fuller Co. of Catasauqua, Pa., for unloading and conveying portland cement, incorporates several new features. Chief among these is the change by which the pumping motor is employed solely for pumping. This change is said to keep the maximum motor power

continuously available for pumping and to make overloading of the pump impossible; it is said that the machine will operate properly when completely buried under cement.

The machine is operated by remote control through a cable. With the remote control device the machine can be made to move forward, backward, and to the left or right. A button on the same remote control switch controls the pump operation independently of the movement of the machine. This remote control feature is said to make it possible for the operator, from a safe distance, to keep the machine moving continuously forward without regard to the danger of slides.

New Equipment in Brief

Shovels—Northwest Engineering Co. has added a ¾-yd. and a ½-yd. convertible shovel to its line, said to incorporate many features generally found only on large machines. They are full revolving and mounted on crawlers. Booms and dipper sticks are all welded; buckets have a manganese front with removable teeth. The engine is a modified eight-cylinder Ford truck model. The design is such that the shovel may be removed from its crawlers and placed on a truck base.

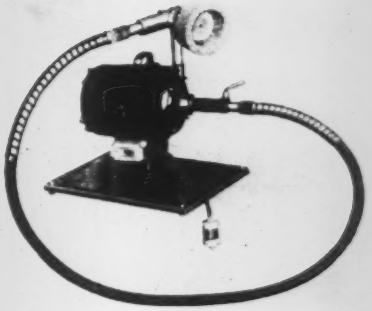
Drafting Machine—New models of the Charles Bruning Co. drafting machines incorporate an adjustable brake mechanism to prevent the protractor head from sliding when used on an inclined board. Each machine also has adjustable skid buttons for leveling the scale. The de luxe civil engineer's model is fitted with a micrometer adjustment screw tangent to the protractor.

Mixer—The T. L. Smith Co. of Milwaukee is bringing out a new half-bag mixer designed along the same lines as their large mixers. The new mixer, the 3½-S, has a charging height of only 34½ in. Power is supplied by a 2½ hp. Stover engine.

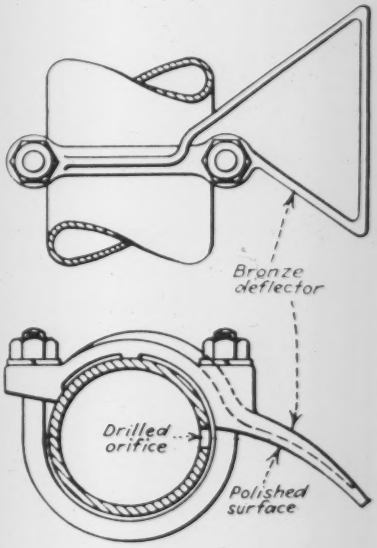
Battery Charger—Model BC of D. W. Onan & Sons of Minneapolis, Minn., is a small 6 volt generator, with a capacity of from 150 to 200 watts, for use in charging batteries or operating floodlights. The machine is also equipped with a pulley for direct power takeoff for operating small machinery. It is said that the charger will operate from 12 to 15 hours on a gallon of gasoline.

Strike-off—The Flexible Road Joint Machine Co. has developed a strike-off machine for striking off concrete below the forms for placement of reinforcing steel. The new machine, the Flex-Plane, is built to ride on the side forms. It is equipped with a reciprocating strike-off blade which can be set to various crowns of the pavement. The machine is powered with a two cylinder 8 hp. engine with a transmission unit for speeds forward and backward. The machine is underslung at the center to permit it to pass under the paver bucket.

Vibrator—The Mall Tool Co. are now manufacturing a lightweight concrete vibrator. The vibrator is designed to operate on either 110 volt a.c. or d.c. current or 220 volt a.c. or d.c. current at a frequency of 9,000 vibrations per minute. The weight is said to be so small that the power unit can be carried in one hand while the vibrator is operated by the other. The vibrator unit consists of a steel reinforced, high specific gravity, off-balance lead weight revolving on double ball bearings inside a totally enclosed steel shell.



THIS CONCRETE FINISHING machine, manufactured by R. G. Haskins Co. of Chicago, is equipped with a ¾ hp. enclosed motor, a 7 ft. heavy duty flexible shaft, and a right angle head with a ball bearing, grease-sealed, 3 to 1 reduction. Two 5½ in. cup wheels are furnished with the machine.



LINK-BELT COMPANY ANNOUNCES a simple, non-clogging spray nozzle described as a smoothly polished, curved, bronze deflector clamped to the water pipe, with a U-bolt, in such a position that it is just above the orifice. The orifice in the pipe need be only a plain drilled hole. The width of the deflector permits use of a comparatively large water jet, and thus allows fairly large dirt particles to pass through the orifice without clogging. To assemble the deflector on the pipe, it is only necessary to place it in proper position over the orifice, and then tighten the nut on the U-bolt.

Manufacturers' Activities

Distributor Appointments

• The Lincoln Electric Co., Cleveland, Ohio, has announced the appointment of the Inter-Mountain Belting and Casting Company as its agent in Denver, Colo., covering Colorado and part of Kansas, Nebraska, and Wyoming.

• The H. W. Porter Company of Newark, N. J., manufacturers of the Therm-O-Tile underground steam pipe system, has recently appointed the following distributors: Canadian-Johns-Manville Co. of Montreal and Toronto, Canada; Johns-Manville Sales Corporation of White Plains, N. Y; Smith-Murray Corporation of Rochester, N. Y.; and P. F. Thorsen Company of South Boston, Mass.

• Products of Rawlplug Company of New York City will be handled by the Rawlplug-Detroit Co., Detroit, Mich.

• Among the distributors recently appointed by the Republic Steel Corporation of Cleveland are: the Conner Manufacturing Co., of Louisville, Distributors of Enduro stainless steel; Taylor-Parker Company of Norfolk, Va., distributor of Republic tubular products; and Charles Millar & Son, of Utica, N. Y., distributors for stainless steel.

Plant Expansion

• To bring under one roof many of the manufacturing operations previously jobbed out, the Cleveland Formgrader Company of Cleveland have recently announced the transfer of its plant to a new location having about five times the area of the old plant.

• General Electric Company, Air Conditioning Department, at Bloomfield, N. J., has established a product division, in charge of Samuel Martin, Jr., to handle installation and servicing of G. E. Air Conditioning Products.

BUSINESS SIDE OF CONSTRUCTION

September Construction Volume Rises on Spurt in Private Work

ENGINEERING construction awards in September climbed to $197,372,000, a weekly average of $49,343,000 and the highest since January when PWA requirements precipitated a peak load of awards for public buildings and other public works. The present rise is due to a sharp increase in private awards. The total for the month is $84,432,000 compared with an average of $50,000,000 for previous months. Public awards total $112,940,000 for September of which $26,289,000 is federal. Corresponding values for a year ago are: total, $114,840,000; private, $14,650,000; public, $100,190,000; federal, $36,765,000.

The cumulative total for engineering construction awards at the end of the third quarter is $1,737,659,000 compared with $1,017,041,000, a gain of 71 per cent over last year. The gain in private construction over last year is 89 per cent.

For the gain in private construction, commercial buildings are chiefly responsible. Due to a heavy volume of medium and large speculative building projects, and apartment houses in New York and New Jersey. Industrial buildings also are higher, while the public work, including public buildings and highways, is slightly lower than last month.

At the end of the third quarter the score stands: waterworks, 49 per cent gain over 1935; sewerage, 83 per cent; waterway, 22 per cent loss; highways, a 64 per cent gain; buildings, a 99 per cent gain.

Territorially, Middle Atlantic registers a big gain for September over August. New England and Southern also show gains. All other territories drop below August. For the first three quarters New England shows a 71 per cent gain over last year; Middle Atlantic, 194 per cent; Southern, 47 per cent; Middle West, 55 per cent; West of Mississippi, 89 per cent; Far West, 40 per cent.

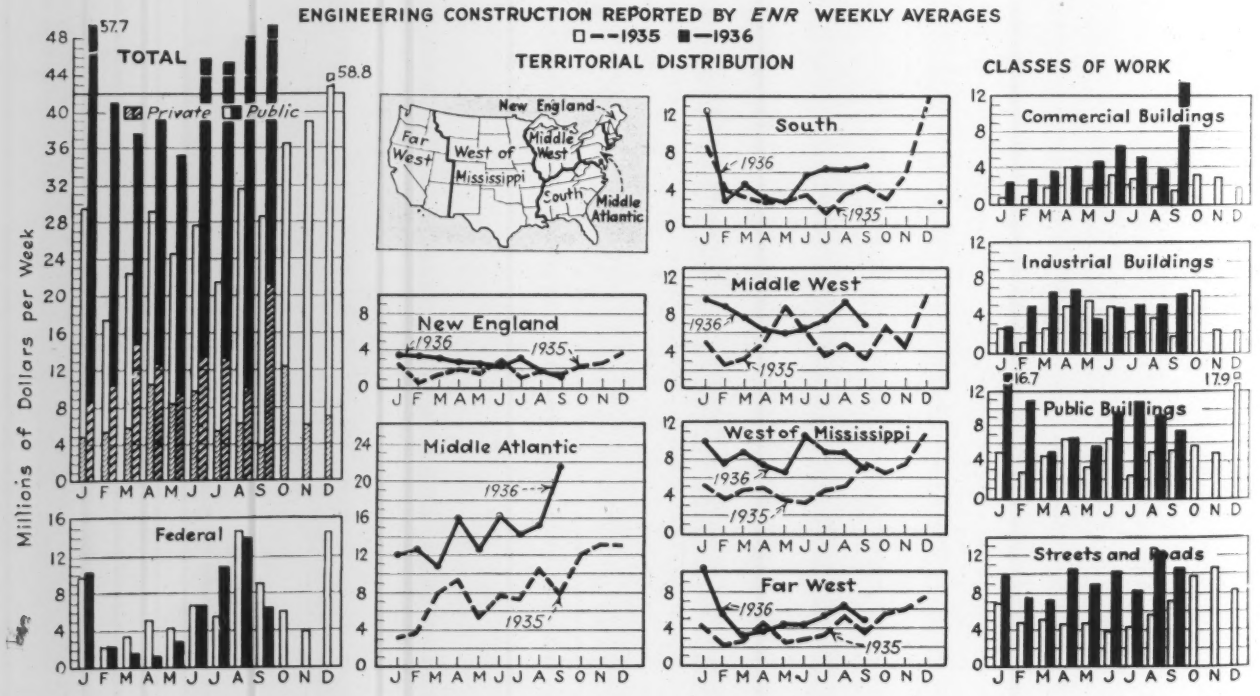
New Capital

New capital for September includes $32,000,000 for PWA allotments, $14,000,000 from purchase of municipal bonds by RFC, $37,000,00 from State and Municipal Bond Sales and $44,000,000 from private corporate securities. The transition from federal to normal financing is widening. Private investment in public and private construction securities increased 74 per cent.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN SEPTEMBER, 1936

Four Weeks—Thousands of Dollars (000 Omitted)

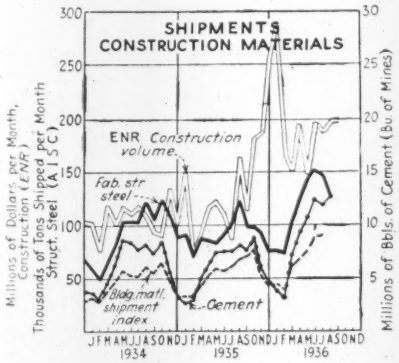
Public Works	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States September 1936	United States Nine Months 1936	United States Nine Months 1935	Canada September 1936
Waterworks	160	459	1,759	965	1,336	2,071	**6,750**	78,986	53,246	75
Sewerage	307	560	228	1,610	1,846	473	**5,024**	95,068	52,045	120
Bridges, public	1,438	2,231	2,862	589	1,619	877	**9,616**	131,881	49,470	2,068
Earthworks and waterways	1,370	1,469	1,748	742	4,605	1,605	**11,539**	141,319	180,067	741
Streets and roads	2,445	9,269	10,715	4,663	9,847	6,194	**43,133**	368,378	201,869	3,253
Buildings, public	2,817	8,913	2,088	6,805	4,643	3,721	**28,987**	357,612	178,152	526
Unclassified, public	132	5,300	238	182	1,363	676	**7,891**	74,516	44,049	318
Total public	8,669	28,201	19,638	15,556	25,259	15,617	**112,940**	1,247,760	758,898	7,101
Federal gov't (included in above classifications)	3,519	4,195	4,092	6,542	5,819	2,122	**26,289**	253,888	255,326	.....
Private										
Bridges, private	25	240	.....	153	.....	23	**441**	9,484	9,532	.....
Buildings, industrial	929	7,635	4,175	6,390	2,963	2,784	**24,876**	195,939	123,101	474
Buildings, commercial	1,011	48,982	1,800	740	640	1,125	**54,298**	197,285	77,492	.....
Unclassified, private	210	1,030	1,165	1,346	759	307	**4,817**	87,191	48,018	130
Total private	2,175	57,887	7,140	8,629	4,362	4,239	**84,432**	489,899	258,143	630
September, 1936 (4 weeks)	**10,844**	**86,088**	**26,778**	**24,185**	**29,621**	**19,856**	**197,372**	.....	.....	7,731
August, 1936 (4 weeks)	7,203	60,850	24,291	39,726	34,664	25,583	**192,317**	.....	.....	10,221
September, 1935 (4 weeks)	6,043	32,158	17,254	13,756	31,160	14,469	**114,840**	.....	.....	8,262
Nine months, 1936	112,271	565,719	223,576	296,139	329,009	210,945	.....	1,737,659	.....	71,077
Nine months, 1935	65,534	279,175	151,128	188,670	189,340	143,194	.....	.....	1,017,041	65,704



ring the first 9 months of this year. PWA allotments under this year's fund are coming through very slowly and financing for non-federal work is lagging 23 per cent behind last year. WPA funds are less than a year ago and help account for a 27 per cent lower total new capital reported for the 9 months.

Materials

Portland Cement—Production for July is reported at 11,446,000 bbl. by U. S. Bureau of Mines and for August, 12,535,000 bbl. Shipments for corresponding months are 11,766,000 bbl. and 12,560,000 bbl., stocks, 18,962,000 bbl. and 18,950,000 bbl. Production and shipments in July showed gains of 42.7 and 50.6 per cent over last year and in August 73.3 and 55.0 per cent gains. Stocks at mills were 15.5 per cent lower in August than a year ago. The ratio of production to capacity is 56.2 for August, 51.3 for July and 52.3 for June compared with 31.8 for August, 1935 and 35.3 for July, 1935.


SHIPMENTS CONSTRUCTION MATERIALS
ENR Construction volume
Fab. str. steel
Bldg. matl. shipment index
Cement
Millions of Dollars per Month, Construction (ENR)
Thousands of Tons Shipped per Month Struct. Steel (A.I.S.C.)
Millions of Bbls. of Cement (Bu. of Mines)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1934
1935
1936

Steel—The average operating rate of steel companies having 98 per cent of steel capacity of the industry who report to American Iron and Steel Institute is 71.7 for the four weeks ending September 28 compared with an average of 71.5 a month ago and 48.2 a year ago. The rate for the last week, however, was up to 74.4 per cent.

Lumber—Lumber production, reported to the National Lumber Manufacturers Association, was 70 per cent of the 1929 weekly average except during the holiday week when it dropped to 65 per cent. Shipments ranged from 63 to 69 per cent of the 1929 average and reached 258,000,000 feet on the 69 per cent week.

Index—The index of shipments of construction materials computed by Advance Construction Programs Unit is 87 for July, 85 for June and 75 for May compared with 60, 58 and 59 for corresponding months last year.

Buildings Permits

The total value of permits in August for 215 cities reporting to Dun & Bradstreet, Inc., was $83,109,753, a decrease of 12.8 per cent from the $95,281,845 reported in July, but an increase of 49.6 per cent above the $55,536,546 recorded in August, 1935.

Permit valuations for New York City (five boroughs) amounted to $12,095,174, as compared with $20,745,393 in July and $12,193,007 for August, last year. This represented declines, respectively, of 41.7 and 0.8 per cent.

For the 214 outside cities the August building volume totaled $71,014,579 compared with $74,536,452 in the preceding month, a loss of 4.7 per cent. Compared with the $43,343,539 recorded in the like month of 1935, however, shows a gain of 63.8 per cent.

Labor

Reports received in August by the U. S. Bureau of Labor Statistics from 8,789 contractors covering 103,511 workers engaged in private building construction showed an increase of 6.1 per cent in employment between July and August and a gain of 9.6 per cent in pay rolls. Employment in this industry in August, 1936 was 23.8 per cent above the corresponding month of last year and pay rolls were 41.8 per cent greater than in August, 1935. The reports cover only employees engaged in erecting, altering, and repairing private buildings.

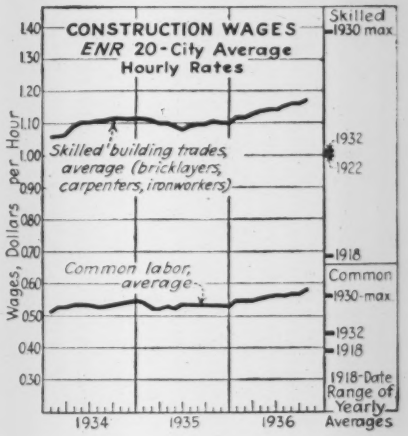
Employment on projects of the works program financed from funds provided by the Emergency Relief Appropriation Acts of 1935 and 1936 was 3,110,000 in August compared with 3,052,000 in July. Projects operated by the Works Progress Administration employed 2,463,000 workers.

August employment on all Public Works Administration projects showed a small decrease compared with the number of workers employed in July. In August more than 340,000 workers were employed on projects financed by the Public Works Administration.

Construction projects financed from regular governmental appropriations employed 145,000 workers compared with 126,000 in July.

Virtually no change occurred in the number of workers employed on the construction and maintenance of state roads. In August 186,000 workers were employed compared with 186,700 in July.

Scarcity of skilled workers and mechanics is reported in a number of cities. A canvass of the situation in some of the larger cities shows a local rather than a national shortage. At Atlanta, Ga., there is a slight stiffening in union wage rates, bricklayers, hoisting engineers and plasterers are in demand, plenty of work for better class of workman, evidence of approaching scarcity but not serious. Baltimore: contractors are beginning to complain of shortage of men in all skilled trades; Boston: no labor shortage, employment conditions better; Cleveland: shortage of bricklayers, sheet metal workers and tile setters; Cincinnati: residence contractors complain of shortage of skilled labor. Two large federal projects, housing and resettlement are absorbing a number of skilled workers; Detroit: no shortage evident; Los Angeles: shortage of skilled labor being felt; Minneapolis: no labor shortage; Denver: shortage felt in building trades. Colorado State Employment Service had to send out a call for 50 men for work at West Portal at 62½c. per hr., 8-hr. day, $1.50 per day room and board.



Skilled wages stiffened sharply this month at a number of centers and mostly in the non-union bracket. The *Engineering News-Record* 20-cities average for 3 skilled trades increased from $1.159 in September to $1.176 for October.

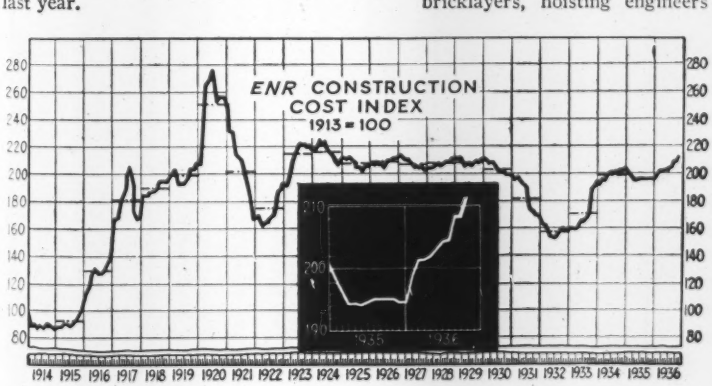
ENR Cost and Volume Index

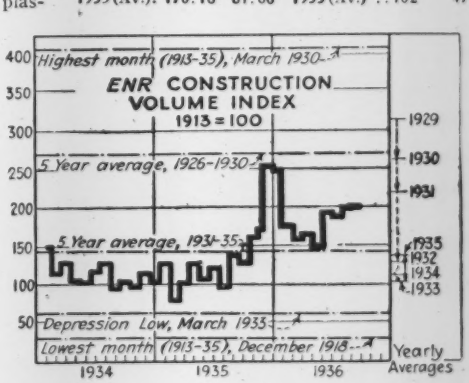
THE *Engineering News-Record* Construction Cost Index rises to 211.50 for October due to an increase in lumber and continued increase in common labor rates.

The *EN-R* Volume Index rises to 200 for September.

INDEX NUMBER

ENR Cost	1913 = 100	1926 = 100	ENR Volume	1913 = 100	1926 = 100
Oct., 1936	**211.50**	**101.67**	**Sept., 1936**	**200**	**88**
Sept., 1936	208.10	100.08	Aug., 1936	199	87
Oct., 1935	195.10	93.82	Sept., 1935	140	61
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47





CURRENT PRICES OF CONSTRUCTION MATERIALS

CEMENT, AGGREGATES AND READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT (Per bbl., carload lots, including 40c. per bbl. for bags, cash discount not included)			SAND AND GRAVEL (Per ton, carload lots)			CRUSHED STONE (Per ton, carload lots)		CRUSHED SLAG (Per ton, carload lots, f.o.b. plant)		CONCRETE
	Cloth Bags*	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	Ready Mix 1:2:4, 50c. y. more, deliver
Atlanta	$2.83	$2.58	$2.50	$1.60	$1.60	$1.55	$1.69	$1.92	$1.69	$1.69	$8.50
Baltimore	2.66	2.41	2.21	1.80‡	1.80‡	1.30‡	1.80‡	1.80‡	1.80	1.80	7.35
Birmingham	2.40	2.15	1.95	1.80	1.80	1.45	1.00	1.00	.90	1.15	5.45
Boston	2.42	2.12	1.92	1.40	1.40	.90	1.40	1.40	.....	.....	6.50
Chicago	2.50	2.25	2.10	1.50	1.50	1.80	1.32	1.32	1.00	1.00	.....
Cincinnati	2.50	2.25	2.05	1.20	1.20	1.30	1.80	1.80	.....	.....	6.70
Cleveland	2.46	2.16	.....	1.40	1.40	1.40	1.60	1.60	1.75	1.75	7.85e
Dallas	2.45	2.20	2.00	1.55	1.55	1.30	1.95	2.05	.....	.....	7.00
Denver	3.09	2.84	.....	1.20	1.40	.90	.....	.....	.....	.....	.....
Detroit	2.25	2.00	1.80	1.30	1.30	1.20	1.50	1.75	1.40‡	1.50‡	5.95
Kansas City	2.51	2.26	2.06	1.85	1.85	1.25	1.85	1.85	.....	.....	7.65
Los Angeles	2.32	2.12	.....	1.20	1.20	.90	1.20	1.20	.....	.....	6.31
Minneapolis	2.80	.....	2.35	1.00p	1.00p	.25p	1.00p	1.00p	.....	.....	6.75d
Montreal	.....	.....	1.70	.80	.85	1.00	1.20‡	1.30‡p	.....	.....	6.50t
New Orleans	2.47	2.22	2.00	1.50	1.50	1.25	.....	.....	.....	.....	8.25
New York	2.70‡	2.45‡	.....	1.20†k	1.20†k	.70†k	1.75†k	1.85†k	.....	.....	8.00
Philadelphia	2.68	2.43	2.23	1.45‡	1.55‡	1.15‡	2.60‡	2.75‡	1.00‡	1.00‡	8.00D
Pittsburgh	2.46	2.21	1.61	1.50‡	1.50‡	1.70‡	2.25‡	2.25‡	1.50	1.50	7.00
St. Louis	2.53	2.28	.....	1.55‡	1.40‡	1.25/1.40‡	.75p	.75p	.65/.95§	.50/.95§	6.95
San Francisco	2.72	2.52	2.20	1.35	1.35	1.35	1.50	1.50	.....	.....	7.53
Seattle	2.95	2.70	.....	1.00	1.00	1.00	1.44	1.44	.....	.....	6.75

*10c. allowed for each returnable bag. †Per cu. yd. ‡Delivered. §F.o.b. Granite City, Ill. kBarge lots alongside dock. pf.o.b. plant. s5 tons or more. wWithin 3-mi. from Pub Square. tton. d 5% discount for cash. D Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Alpena, Mich	$1.50	$1.45	Ironton, Ohio	$1.50	$1.45	North Birmingham, Ala.	$1.75	$1.70
Buffington, Ind	1.70	1.65	Iola, Kans	1.70	1.65	Richard City, Tenn.	1.85	1.80
Crestmore, Calif.	1.72	.....	La Salle, Ill.	1.70	1.65	Saginaw, Mich.	1.40	1.35
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	Limedale, Ind.	1.70	1.65	Steelton, Minn.	1.80	1.75
Hannibal, Mo	1.70	1.65	Mason City, Ia.	1.70	1.65	Universal, Pa.	1.65	1.60
Hudson, N. Y.	1.75	1.70	Norfolk, Va.	1.76	1.71	Waco, Tex. (Plus 5c. Tax in Texas)	1.75	1.70
Independence, Kans.	1.70	1.65	Northampton, Pa.	1.65	1.60	Wyandotte, Mich.	1.45	1.40

Cash Discounts, Cement, to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount, 10c. per bbl. for payment within 15 days of date of invoice.

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE—PARTITION—SCORED (Per M, lots of 2,000 pieces or over)			STRUCTURAL CLAY TILE—LOAD BEARING—SCORED (Per M, lots of 2,000 pieces or over)			BRICK (Per M, in quantity)		LIME (Per ton, in paper)		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Hydrated finishing	Common hydrated	carload lot Pulverized or lump
Atlanta	$71.10	$75.80	$142.10	$170.50	$199.00	$227.40	$12.25	$14.25	$19.50	$14.00	$14.00
Baltimore	91.00	98.00	183.00	219.00	315.00	390.00	13.00	17.00	20.00	14.00	25.00
Birmingham	78.75	84.00	157.50	189.00	201.25	242.00	15.00	19.00	3.00§	1.75§	2.25§*
Boston	79.90,t	85.20,t	159.75,t	181.05,t	237.30,t	271.20,t	14.50	18.00	20.00	15.50	3.50*
Chicago	66.00	70.40	132.00	174.30	214.40	245.00	10.20	11.20	18.00	13.40	14.00
Cincinnati	58.85	62.80	117.75	141.30	169.26	209.56	17.50	17.50	15.97	12.48	.....
Cleveland	45.00	48.00	90.00	108.00	138.50	158.50	13.75	13.75	16.00k	14.00k	2.65kp
Dallas	68.00	67.00	140.00	160.00	190.00	260.00	13.00	24.00	19.00	16.00	1.55p
Denver	78.50	88.00	141.50	166.50	196.00	225.00	11.50	15.00	30.00k	22.00k	22.50k
Detroit	71.85	76.65	143.70	230.00	280.00	325.00	12.50	13.50	18.00	15.00	15.25
Kansas City	64.50	66.50	81.00*	125.50	159.75	186.25	13.00	22.00	18.90	12.40	10.35
Los Angeles	77.50	94.25	134.00*	188.00	232.50	311.50	11.50	14.00	18.70	.....	19.70
Minneapolis	80.15s	85.50s	145.40s	167.75s	175.25s	243.70s	13.10	15.10x	25.50	21.00	23.00
Montreal	84.00s	96.00s	180.00s	273.00	.....	.....	20.75	31.00	15.00	10.00	7.00
New Orleans	69.10	69.10	129.50	155.40	203.40	251.80	14.00	.....	18.40	11.25	.....
New York	78.40	83.60	125.40*	193.30†	238.80†	295.60†	12.50	.....	20.00	15.50	20.00
Philadelphia	86.00	90.00	150.00	200.00	240.00	280.00	18.00	20.00	16.35	11.25	10.75
Pittsburgh	58.40c	62.30c	116.85c	165.00c	217.00c	250.00c	16.50	25.00	17.20	14.50	2.22p
St. Louis	62.00	65.00	120.00	180.00	234.00	280.00	15.00	18.00	22.00	16.00	2.30p
San Francisco	84.00	94.50	225.00	.....	.....	.....	15.00	18.00	.55§	.40§	2.05p
Seattle	84.00	95.00	180.00	198.00	.....	.....	15.50d	18.50	30.00	20.00	28.60p

6x12x12 in. †F.o.b. Perth Amboy, N. J. ‡Per sack. §Per bbl., 200 lbs. pPer bbl. 180 lbs. qper bbl. 280-lb. kLCL. dless $1 cash 15 days. *lump. sSmooth xSelected common. tCarload lots delivered to job.

ROAD SURFACING MATERIALS—F.O.B. CITY

	PAVING BRICK AND BLOCKS			PAVING ASPHALT (Per ton, less than 80 penetration)		ASPHALT BINDERS—FLUXES (Per gal., 80-300 penetration)		CUTBACK ASPHALT (Per ton)		ROAD OILS (Per gal.)	ASPHALT EMULSION (Per gal.)	
	Granite per M, lots of 50,000, 4x4x8 in.,	Brick per M, 3x4x8½ in., carload lots	Wood per sq. yd., 3½ in., 16-lb. treat,	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$ 75.00	$35.00	$2.25	$17.40z	$ 2.62z	$0.0687z	$0.100z	$18.15z	$26.20z	$0.687z	$0.0875	$0.0875
Baltimore	108.00	44.00	2.25	17.00	22.00	.075	.10	.09†	.125†	.....	.....	.....
Birmingham	110.00	25.00	.....	19.00	24.00	.0878	.1128	.10†	.137†	.....	.06	.....
Boston	75.00	46.00	2.75	17.00	22.00	.07e	.095e	.09†e	.12†e	.07e	.095e	.125e
Chicago	125.00	42.00	1.985	16.00	20.00	15.00	19.00	.07	.11	.045	.09	.135
Cincinnati	115.00	37.00	.....	13.47	17.47	.12	.....	17.00	.....	.055	.08	.....
Cleveland	100.00‡	32.50	2.85	17.50	21.20	.075	.094	.085	.055†	.0575	.085	.095
Dallas	.....	30.00	.....	18.00	21.75	.065	.16	18.75	26.25	.055	.085	.11/.135
Detroit	.....	37.00	.....	16.80x	21.00x	.....	.....	15.25	20.25	.055	.11	.15
Kansas City	.....	40.50	.....	18.50	23.50	17.50#	22.50#	.077†	.107†	.057	.11	.15
Los Angeles	.....	50.00	.....	10.34	14.50	10.34#	14.50#	10.34	.....	.042	.06	.12
Minneapolis	.....	.....	1.75l	18.20	24.70	.098	.098	21.85	34.65	.048	.....	.....
Montreal	85.00	60.00	3.62	14.00	20.00	.10	.13	.0975†	.1175†	.0675	.135	.165
New Orleans	100.00	32.00	.....	15.20	18.75	.068	.095	.075†	.10†	.....	.0785	.11
New York	120.00§	65.00	2.75	17.00	22.00	.075	.10	.09†	.125†	.....	.075	.11
Philadelphia	110.00	45.00	2.25	13.50	18.00	.05	.08	.05†	.08†	.045	.08	.....
Pittsburgh	115.00	40.00	.....	19.00	24.00	.0775	.1125	.086†	.121†	.0675	.....	.....
St. Louis	115/120	35.00	.....	19.70	24.70	.08775	.1075	.0825†	.1125†	.045	.09	.12
San Francisco	.....	50.00	.....	12.00	18.00	12.00#	18.00#	12.50#	23.00#	.04	.0575	.117
Seattle	.....	35.00	.....	25.50	25.50	17.00#	23.00#	15.00	.....	.03	.19	.20

Note: Paving asphalt, tank car or boat, f.o.b. Maurer, N. J., per ton. Bermudes, $25.00; Trinidad, $21.00. *Per sq. yd. †Per gallon. ‡4½x6x5½ in. #per ton §4x5x9-in. Av. xMexican. zLocal reduction due to 20% reduction intra-state class freight rates, only Georgia affected. l 2½ in. 6 to 8-lb. treatment. e F.o.b. Everett

CURRENT PRICES OF CONSTRUCTION MATERIALS

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¾-in. billet,	RIVETS ¾-in. structural	WIRE NAILS Base	SHEET PILING Base	STEEL RAILS Per Gross Ton Standard	Light	Re-rolled	TRACK SUPPLIES Angle bars	Std. spikes	Tie plates	Track bolts
Birmingham	$2.05	$2.10	$3.15	$2.25		$36.375	$35.00	$34.00	$2.55	$2.60	$1.90	$3.60
Chicago	1.95	2.10	3.15	.....	$2.35	36.375	35.00	34.00	2.55	2.60	1.90	3.60
Pittsburgh	1.90	2.05	3.05	2.10	2.25	36.375	35.00	34.00	2.55	2.75	2.00	3.75

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

F.O.B. WAREHOUSE	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS Per 100 lb., ¾ in., base price New billet	Rail steel	EXPANDED METAL LATH Per 100 sq.yd., carload lots Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING Per 100 s.f., carload lots 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires Per sq.yd.	SHEET PILING Per 100 lb base price
Atlanta	$3.36	$2.34	$2.19	$21.00	$23.00	$1.53	$1.16	$0.1449	$2.70
Baltimore	3.00	2.75	2.60	24.00	26.00	1.41	1.08	.1332	2.45
Boston	3.74	3.10	2.062	22.00†	24.00†	1.46	1.12	.1449	2.67
Chicago	3.20	2.10	1.95	20.00	22.00	1.40	1.08	.1323	2.35
Cincinnati	3.40	3.25	3.25	25.01	29.50	1.39	1.07	.1287	.....
Cleveland	3.31	2.75	2.60	20.00	22.00	1.37	1.06	.1287	.....
Dallas	3.45z	2.825z	2.675z	22.00	28.00	1.63	1.23	.1548	3.005
Denver	3.95	3.76	3.61	22.00	25.00	1.68	1.26	.1584	.....
Detroit	3.52	2.20	2.05	20.00†	22.00†	1.41	1.08	.1323	2.53
Kansas City	3.85	2.75	2.60	19.00	21.00	1.50	1.14	.1422	2.79
Los Angeles	2.35	2.475	.....	23.00	27.50	1.68	1.26	.1584	2.65
Minneapolis	3.55	2.86	2.71	22.00	26.00	1.51	1.15	.1431	2.67§
Montreal	3.25	2.15	2.15	32.50	35.50	2.46	1.82	.253	2.30
New Orleans	.....	.....	.....	20.50	23.50	1.54	1.17	.1458	.....
New York	3.47	2.50	2.35	19.50	21.50	1.44	1.11	.1359	2.50
Philadelphia	3.10	3.06	2.22	20.00	24.00	1.42	1.09	.1332	2.56
Pittsburgh	1.90‡	1.85‡	1.90‡	20.00‡	22.00‡	1.34	1.04	.1260	2.25
St. Louis	3.55	2.45	2.30	22.00	25.00	1.42	1.09	.1341	2.30
San Francisco	3.40	2.475	2.325	23.00	28.00	1.68	1.26	.1584	2.60
Seattle	3.55	2.50	.....	24.50	26.50	1.68	1.26	.1584	2.60

‡Base Mill Price. Note: Shapes, bars and piling subject to quantity discounts. §Mill Price plus freight to Minneapolis. †f.o.b. delivered z f.o.b. Houston

PAINTING AND ROOFING SUPPLIES—F.O.B.

	RED LEAD Per 100 lb. in 500-lb. lots Dry	WHITE LEAD Per 100 lb. in 500-lb. lots# in oil	READY-MIXED PAINT Per gal., drums Graphite*	Aluminum†	Ferric Oxide‡	ROOFING SUPPLIES Carload lots, f.o.b. factory Rolls, slate surfaced, 85-90 lb., per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating, per gal.	Tar pitch, 350--lb bbl., per ton
Atlanta	$7.75	$11.00	$1.60	$2.50	$1.40	$1.94	$1.61	$1.61	$.36	$25.60
Baltimore	7.00	10.50	1.45	2.25	1.70	2.03	3.00	3.00	.35	25.00
Birmingham	7.25	11.00	2.35	2.35	1.85	2.01	1.77	1.77	.36	22.00
Boston	7.00	10.50	1.80	2.60	.0475x	1.75	3.15	3.15	.42	20.00
Chicago	7.00	10.50	1.35	.....	.....	2.47	2.23	2.24	.32	33.00
Cincinnati	7.00	10.50	1.45	2.50	1.40	2.40	2.39k	2.39k	.36	21.00
Cleveland	7.00	10.50	1.70	2.45	1.40	1.55	1.75k	1.75k	.23	19.00
Dallas	7.25	11.50	1.80	2.10	.....	2.35k	3.80	3.80	.14	35.00
Denver	7.50	11.25	2.55	.....	.....	2.25	3.55	3.55	.35	30.00
Detroit	7.00	10.50	1.65	2.30	1.40	2.50	2.65	2.50	.35	30.00
Kansas City	7.00	10.62½	1.65	2.65	1.10	1.78	3.15	3.15	.25	24.50
Los Angeles	7.25	10.75	1.60	2.25	2.30	2.00	1.50	.....	.45	.....
Minneapolis	7.00	10.62½	.....	.....	.....	1.75v	1.52kv	1.52kv	.29	23.80
Montreal	.....	8.20	2.00	4.75	2.40	2.50	1.60	1.83	.50	1.52§
New York	7.00	10.50	1.75	2.35	1.50	1.70	1.52k	1.52k	.232	22.00
Philadelphia	7.00	10.50	2.50	2.95	1.50	1.68	1.85k	1.48k	.37	22.00
Pittsburgh	7.00	10.50	1.05	1.95	.80	1.75	1.65k	1.65	.38	25.00
St. Louis	10.00	10.50	1.85	2.45	1.30	1.83k	2.57	2.57	.25	25.00
San Francisco	7.25	10.75	1.80	2.75	1.10–2.00	1.89	3.10	3.10	.38	26.00
Seattle	7.25	10.75	1.80	2.85	2.20	3.30	2.66	2.60	.60	30.00

*U. S. War Dept. Spec. 3-49A. †ASTM Spec. D266-31. ‡80% maximum ferric oxide. §Per 100 lb. kPer roll, 65 lb. xPer lb. v Minneapolis & vicinity
Note: Red lead in oil 50c higher than white lead in oil. #Basis of quoting changed this month from list to 500-lb. lots.

MISCELLANEOUS ITEMS

WINDOW GLASS

Discounts from latest jobbers List, Sept. 15, 1928, Single or Double Thickness

	A quality	B quality
Atlanta	80%	80%
Baltimore	88%	90%
Birmingham	88%	90%
Boston	88–10–5%	90–10–5%
Chicago	87%	88%
Cincinnati	89–10%	91–10%
Cleveland	85%	85%
Dallas	87%	89%
Denver	88%	90%
Detroit	87–10%	89–10%
Kansas City	85–10%	86–10%
Los Angeles	90%*	90–40%
Minneapolis	86%	87%
Montreal	60–30%	70–5%
New Orleans	88%	90%
New York	89%	90%
Philadelphia	89%	90%
Pittsburgh	88%	88%
St. Louis	89%	89%
San Francisco	80%	85%
Seattle	90–10%	90–20%

*Disc. from list Aug. 1, 1929.

EXPLOSIVES

Per lb. dynamite delivered 50-lb. cases, Gelatin

	40%	60%
Atlanta	$0.135	$0.15
Baltimore	.145	.16
Birmingham	.095	.11
Boston	.13	.145
Chicago	.135	.15
Cincinnati	.27	.29
Cleveland	.215	.225
Dallas	.1350	.1500
Denver	.145	.16
Detroit	.204	.235
Kansas City	.35	.15
Los Angeles	.1725†	.1925†
Minneapolis	.145	.16
Montreal	.18	.1925
New Orleans	.215	.23
New York	.215	.23
Philadelphia	.13	.1450
Pittsburgh	.10	.115
St. Louis	.13	.145
San Francisco	.1475	.1625
Seattle	.1425	.1575

†F.o.b. Arsenal. ‡Double thickness A & B.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York.

Bleaching powder, in drums, F.o.b. works, per 100-lb	$2.00–2.25
Calcium chloride, 77-80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, f.o.b. works, freight equalized with points of competition, per ton	22.00–34.00
Chlorine cylinders, per lb. delivered	.055
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb	1.35
Soda ash, 58%, in paper bags, per 100 lb. dense	1.25
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	27.00–30.00
Sulphate of copper, in bbl., per 100-lb	4.00

PILES

Prices per linear foot, pine, with bark on, f.o.b. New York; delivered from barge 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Short Leaf Barge	Short Leaf Rail	Long Leaf Barge	Long Leaf Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.16	$0.195	$0.16	$0.19
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.20	.24	.18	.23
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21	.255	.19	.24½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.23	.265	.23½	.27½
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.25	.275	.27½	.33½
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.32	.415	.....	.....
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.35	.482	.....	.....

RAILWAY TIES

Prices f.o.b., per tie, for carload lots:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Boston	Oak, untreated	$1.00	$1.50
	Pine, untreated	1.15	1.50
	Pine, creosoted	1.55	2.10
New York	Long-leaf sap pine, untreated	1.05	1.25
	Mixed oak, untreated	1.20	1.40
	White oak, untreated	.85	1.35
Birmingham	Red oak, creosoted	1.50	1.70
	Southern pine, untreated *6x8x8'6"	.55*	.70
	Southern pine, creosoted	1.10*	1.30
Chicago	White oak, untreated	1.15	1.40
	Oak, empty cell, creosoted	1.50	1.88
	Oak, zinc treated	1.40	1.70
	Southern pine, creosoted	1.35	1.78
Los Angeles	Fir, untreated	.50	.72
	Fir, creosoted	1.67	2.40
Philadelphia	Red oak, untreated	1.00	.....
	Red oak, creosoted	.....	2.10
St. Louis	White oak, untreated	1.03	1.45
	Red oak, untreated	1.10	1.40
	Red oak, creosoted	1.50	1.95
San Francisco	Sap Pine or cypress, untreated	.85	1.20
	Douglas fir, green, untreated	.45	.63
	Douglas fir, empty cell, creosoted	1.14	1.56
Montreal	Birch or maple, untreated	.65	.75
	Birch or maple, creosoted	1.05	1.35

CURRENT PRICES OF CONSTRUCTION MATERIALS

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE	VITRIFIED SEWER PIPE				CLAY DRAIN TILE		CONCRETE SEWER PIPE		WROUGHT STEEL PIPE			
		Per foot, delivered, ASTM C 13-35								Full standard weight. #			
	Per net ton, f.o.b. 6 in. to 24 in.*	8 in., s.s.	12 in., s.s.	24 in., d.s.	36 in., d.s.	Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	Per ft., delivered; ASTM C 14-35 12 in.	24 in.	1 to 3 in., Butt Weld Black	Galv.	3½ to 6 in., Lap Weld Black	Galv.
										%	%	%	%
Atlanta	$43.00	$0.25dl	$0.45dl	$1.625l	$4.50l	$80.00	$128.00	$0.45	$1.625	49.5	40.5	47	37.5
Baltimore	46.50	.28	.54	2.38	7.18	110.00	170.00	.40	1.60				
Birmingham	39.00	.25	.45	1.625	4.66	85.00	220.00	.40	1.60	69.5	61.5	67	58.5
Boston	46.50	.224	.432	1.98	5.845	99.00	153.00	.42	2.35				
Chicago	47.50	.245	.4725	2.025	4.60	60.00	120.00	.36	1.42	58.75	48.75	55.625	45
Cincinnati	46.00	.189	.3645	1.62	5.535	69.00	108.00	.40	1.40	58.75	48.75	55.625	45.00
Cleveland	47.50	.168	.324	1.44	4.1225	42.50	88.50	.32	1.64	61	51	57.9	47.25
Dallas	51.00	.35	.67	2.70	.....	165.00	260.00	.46	1.57	69.5	61.5	67	58.5
Denver	59.00	.27‡	.47‡	1.98‡	.....	105.00	180.00	.....	.....	50	40	47	36
Detroit	47.50	.203	.3915	1.71	5.2375	82.00	136.00	.35	1.20	59.3	49.3	56.1	45.5
Kansas City	49.00	.30	.54	2.16	5.00	120.00	140.00	.40	1.50	55	45	51.5	41
Los Angeles	47.50	.2825‡	.508‡	2.03‡	5.535‡	115.50	192.50	1.00	2.00	62.1	54.1	59.6	51.1
Minneapolis	49.50	.24‡	.432‡	1.728‡	4.60‡	.....	.....	.65	1.75				
Montreal	50.00	.33‡	.59‡	2.04c‡	.....	82.00	134.00	.51	2.04	.....	.....	.....	.....
New Orleans	45.00	.23	.41	1.60		67.00	.....	.47	1.67				
New York	46.00	.26	.51	2.25	6.15			.55	2.00	57.50*	47.50*	54.375*	43.75*
Philadelphia	43.00	336	.648	2.835	8.68	175.00	210.00	.54	1.80	52.37*	41.35*	53.39*	42.57*
Pittsburgh	49.00	.182‡	.351‡	1.62‡	4.92‡	69.00	108.00	.75c	1.75	69.5	61.5	67	58.5
St. Louis	46.00	.258	.459	1.83	3.96	85.00	170.00	.80	2.00	57.125	47.125	54	43.375
San Francisco	47.00	.29L	.522L	2.088L	5.67L	103.50	172.50	.45	2.20	53.69	47	50	39
Seattle	48.50	.4225	.63†	3.06†	7.55†	85.00	200.00†	.50†	1.80	65.80	57.25	66.75	56.30

*b. & s. class B and heavier, C/L lots, 200 tons and over. Burlington, N. J. (base) $43.00. Gas pipe and class A, $3 per ton additional. 4-in., $3 per ton additional. 30 in. and larger usually $2 per ton less.

#Discounts from standard list for delivery from warehouse, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¾ in., 8½c; ¼ in. 11½c.; 1 in. 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92.

‡f.o.b. †Less 30% in C/L Lots. c Concrete Culvert pipe reinforced. dDouble strength. lList to dealers. L list. tSales & municipal taxes extra. ‡2½ to 3 in. *Resale price to consumer, car load lots shipped from mill.

LUMBER AND TIMBER—PER M FT. B.M., CARLOAD LOTS F.O.B.

		SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. All Fir planks No. 2 common; Fir timber is No. 1 common. Lengths up to 20 ft.								LONG LEAF Y. P. Merchantable grade up to 20 ft.	
		1x6,S	1x8,S	2x4,S	2x6,S	2x8,S	2x10,S	3x12,R	6x12,R	12x12,R	2x12,R	12x12,R
Atlanta	Southern Pine	$16.50	$16.50	$16.50	$18.50	$18.50	$20.00	$24.00	.....	.....	$38.50	$38.50
Baltimore	Southern Pine	23.50	24.50	27.50	26.50	27.00	29.00	37.50			55.00	57.00
	Douglas Fir	29.50	29.50	28.50	29.50	28.50	28.50	30.50	$29.00	$29.00	.....	.....
Birmingham	Southern Pine	21.00	21.00	22.00	20.00	21.00	23.00	30.00	30.00	28.00		
	Long Leaf	22.00	22.00	25.00	24.00	25.00	28.00	45.00	.....	.....	45.00	45.00
Boston	Roofers N.C. Pine	28.00	28.00	33.00†	35.00†	49.00†	60.00†	73.00†			73.00	73.00
	Douglas Fir	27.00	27.00	31.00	33.00	35.00	37.00	40.00	40.00	41.00		
Chicago	Southern Pine	29.00	29.50	33.50	32.50	32.50	35.50	45.50			54.50	54.50
Cincinnati	Southern Pine	25.50	25.50	26.50	26.00	27.00	29.00	43.00			45.50	55.50
	Douglas Fir							43.75	43.75	43.75		
Cleveland	Southern Pine	30.00	32.00	38.00	32.00	36.00	38.00	49.00	44.00/	46.00/	52.00	64.00§
Dallas	Southern Pine	d28.35	30.60	31.50	29.80	30.15	30.15	50.00	82.50	66.50	42.75	67.95
Denver	Douglas Fir	42.00	42.00*=	43.00*	43.00*	43.00*	47.00*	52.00*	56.00*	61.50		
Detroit	Southern Pine	27.50	27.50	27.50	27.50	27.50	31.25	38.50			32.50	44.50
	Douglas Fir							43.50	43.50	44.00		
Kansas City	Southern Pine	25.50	26.00	26.50	25.50	26.50	27.00	35.00			50.00	60.00
	Douglas Fir	27.00	28.00	29.00	28.00	29.00	29.00	33.00	36.00	36.00		
Los Angeles	Douglas Fir	32.00„	32.00„	32.00„	32.00„	34.00„	34.00„	36.00„	45.00„	40.00„		
Minneapolis:c	Western Pine	45.00*	51.50*	50.00*	41.00*	41.00*	42.00*				58.00*^	
	Douglas Fir	42.00*	42.00*	43.00*	43.00*	43.00*	43.00*	55.00*	59.50*	59.50*	54.00	
Montreal	Pine	45.00	45.00	49.00	47.00	48.00	58.00					
	Douglas Fir	39.50	39.50	40.00	40.00	40.00	41.50	42.00	42.00	42.00	82.00	76.00
New Orleans	Southern Pine	23.50	25.50	28.00	25.00	27.00	25.50	38.00	.....	.....	44.00	54.00
	Douglas Fir	28.50	30.00	33.00	29.00	32.00	33.50	37.00	.....	.....		
New York	Southern Pine	34.00*	35.00*	33.00*	35.00*	35.00*	36.00*	45.00*			74.00*	74.00*
	Douglas Fir			38.00*	38.00*	39.00*	39.00*	40.00*	44.00*	44.00*		
Philadelphia	Southern Pine	30.00	31.00	32.00	32.00	33.00	34.00	36.00			36.00	42.00
	Douglas Fir	45.00	45.00	45.00	45.00	45.00	45.00	45.00	42.00	42.00	.....	.....
Pittsburgh	Southern Pine	30.50	31.90	37.65	33.75	36.52	37.50	47.75			57.50	57.50
	Douglas Fir	38.52	39.70	39.70	38.55	39.10	39.38	53.25	53.25	53.25	.....	.....
St Louis	Southern Pine	28.50*x	29.50*x	29.50*x	28.50*x	29.50*x	30.50*x	46.00*x				
	Douglas Fir								54.00*x	54.00*x	71.00	70.00
San Francisco	Douglas Fir	20.50'	20.50'	21.00'	21.00'	21.50'	22.50'	22.00'	22.00'	22.00'	.....	.....
Seattle	Douglas Fir	15.50	15.50	15.50	14.50	14.50	14.50	21.00	20.00	20.00	.....	.....

*Delivered. †Spruce. ‡Long-leafed Y .P. §Norway Pine. ^Northern Pine. =Native. tAt ship's tackle. „Yard prices. d10% Disc. taken off. x5M ft. or less S4S. 'Rgh. cContractors in Minneapolis and St. Paul get 15% disc. from list. f Douglas Fir.

CURRENT BUILDING AND CONSTRUCTION WAGE RATES PER HOUR

	Bricklayers	Carpenters	Structural Iron Workers	Hoisting Engineers	Plasterers	Common Labor — Building	Common Labor — Heavy Const.
Atlanta	$1.125	$0.40/1.00	$1.25	$1.00/1.50	$1.00	$0.30/.40	$0.30/.40
Baltimore	1.25	1.10	1.37½	1.25	1.25	.45	.45
Birmingham	1.00	1.00	1.25	1.125	1.00	.30/.40†	.30/.40†
Boston	1.30	.70/1.175	1.20	.90/1.425	1.375	.50/.625	.50/.70
Cincinnati	.80/1.375	.65/1.20	1.25	1.00/1.25	.80/1.375	.45	.45
Chicago	1.50	1.50	1.50	1.50	1.50	.95	.95
Cleveland	1.375	1.25	1.25	1.25	1.375	.82	.82
Dallas	.65/1.00	.65/1.00	.65/1.00	65/1.00	.65/1.00	.35/.50	.35/.50
Denver	1.25	1.25	1.25	.....	.....	.625	.625
Detroit	1.25	1.00	1.25	1.25	1.25	.50/.75	.60
Kansas City	1.325	1.25	1.25	1.25	1.425	.80	.45/.50
Los Angeles	1.10	1.10	1.125	1.125	1.25	.60	.60
Minneapolis	1.25	1.00/1.10	1.00/1.25	1.00/1.25	1.35	.60/.75	.60/.75
New Orleans	1.00	.75	1.00	1.00	1.25	.30/.40	.30/.40
New York	1.50	1.40	1.475/1.65	1.50/1.5625	1.50	.82½	.50/.80
Philadelphia	.35/1.50	.65/1.10	.70/1.375	.90/1.00	1.10/1.37	.35/50	.40/.50
Pittsburgh	1.50	1.25	1.375	1.00	1.50	.70	.50
St. Louis	1.50	1.25	1.47	1.57/1.75	1.50	.78¾	.35/.78¾
San Francisco	1.50	1.125	1.37½	1.12½	1.50	.875	.60
Seattle	1.00	1.00	1.25	1.25	1.25	60	.60
Monteral	.70	.60	.80	.55	.70	.35	.40

Skilled Avg.: (Bricklayers, Carpenters, Ironworkers) $1.176 Common Avg. $0.583 † PWA